This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

THE HILL KINK BOOKS

PRESS TOOL KINKS

COLVIN-STANLEY

Library
of the
University of Wisconsin

THE HILL KINK BOOKS

PRESS TOOL KINKS

THE HILL KINK BOOKS

Compiled by F. H. Colvin and F. A. Stanley
Associate Editors of the *American Machinist*

Each cloth, 4x6, illustrated, 50 cents postpaid

ORDER NOW

PRESS TOOL KINKS
SCREW THREAD KINKS
PATTERNMAKING KINKS
MILLING MACHINE KINKS
REPAIR KINKS
TOOLMAKERS' KINKS
JIG AND FIXTURE KINKS
DRILL PRESS KINKS
DRAWING ROOM KINKS
SCREW MACHINE KINKS

McGRAW-HILL BOOK COMPANY
Publishers, Booksellers and Importers
239 WEST 39TH STREET, NEW YORK
6 BOUVERIE STREET, LONDON, E.C.

THE HILL KINK BOOKS

PRESS TOOL KINKS

COMPILED BY

F. H. COLVIN AND F. A. STANLEY

Associate Editors of the American Machinist

NEW YORK
McGRAW-HILL BOOK COMPANY
239 WEST 39TH STREET
1908

COPYRIGHT, 1907, BY THE HILL PUBLISHING COMPANY

146788
OCT 5 1910
TDO
.C72

6935303

INTRODUCTORY WORD

THE kinks and other information given in this book have been selected from the experience of thoroughly practical men, as originally published in the *American Machinist.* This volume forms one of a series of this nature, aiming always to make available out-of-the-way information when most wanted. In this form the Kink Books, which can be kept in the tool-chest or the pocket, and always referred to, will, we feel, meet a demand and serve a good purpose.

F. H. COLVIN.
F. A. STANLEY.

NEW YORK, November, 1907.

PRESS TOOL KINKS

STOPS FOR PUNCH-PRESS FEEDS

THERE are very few modern machine tools that are not supplied with a feed of some sort or other, but the ordinary punch press is a notable exception to this rule. There are a great variety of feeds for the punch press, but they are more in the nature of attachments for the machine than part of the machine itself. The reason for this, we believe, is because the work is fed into the punch press in such a great variety of ways; therefore, in many cases it is necessary to design the feed to suit the job, and there is no one feed so universally applicable as to warrant making it part of the machine. The most simple form of feed is where a stop is used, against which the end of the bar or strip being operated on is pressed, the machine shearing off a certain portion at each stroke, as in shearing off bar iron. Two of the stops here shown are of this simple nature, but there are features about them that must be learned in order to operate them successfully. The first one is very simple and successful, and

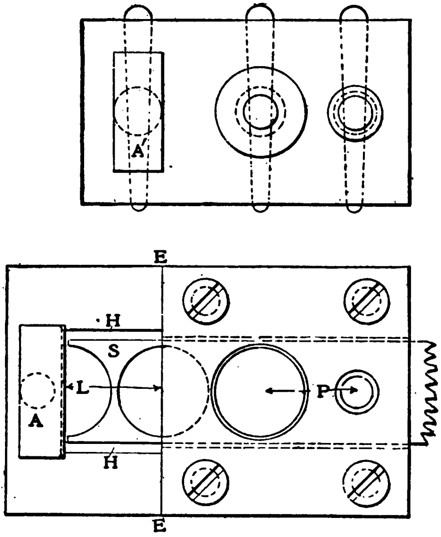


Fig. 1. — Stop and Shear for Disposing of Scrap.

has almost universal application in connection with a gang punch that is punching a single row of blanks from strip steel. The principle of its construction is shown at Fig. 1. This figure shows a punch and die for punching a single row of washers. As will be seen, the die is left long enough to contain the hole *H;* this hole should be made large enough so that the section *S*, of the strip, can fall through easily after it is sheared off with the shearing punch *A′*; then all that is necessary is to keep pressing the end of the strip *S* against the stop *A*, and at each stroke of the press the punch *A′* will shear off the portion shown projecting beyond the stripper; this falls into a box or keg below.

As shown here, the stop *A* is attached directly to the die; this is preferable because the die is then self-contained, and the stop never need be adjusted; it is, however, not necessary, as the stop can be attached to the bolster or any convenient place, and the end of the die, which would then be along the line *E*, can be used for a working edge for the shearing punch *A′*. One feature should be watched very closely, to see that the length of the space, *L*, from the shearing edge to the stop, is a little greater than the distance from center to center of the punches *P;* $\frac{1}{64}$-inch longer is about right. This causes the pilot to pull the strip away from the stop, and allows the piece that is sheared off to drop through perfectly free; while if *L* is made just the length of *P*, or shorter, the pieces will have to be forced through this space, and will very likely force either the stop or the die out of place. We once suggested this idea to the superintendent of a good-sized plant, where they had a great deal of work of this class and were trying to devise a suitable feed; the superintendent said he had tried the idea and found it no good, as it forced the die out of place; and walked away without giving us an opportunity to explain why the die was forced out of place; he later spent a great deal of time and several hundred dollars experimenting with roll-feeds for work that in our opinion would have been better done by this simple device. If it is made as shown in Fig. 1 it is self-contained, needs no adjustment, and there is nothing to get out of order, while the roll-feed takes considerable time to adjust and then it has to be watched very closely to see that the jar of the machine does not work something loose. Although we have never been able to make a test, we believe more work can be turned out with the stop because it is much handier to get the strips in. Another of its advantages is the fact that it cuts the scrap in small pieces, which drop into a box or keg convenient to handle.

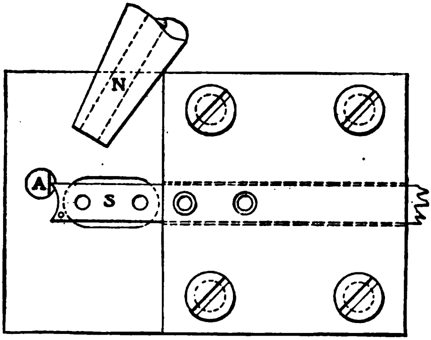


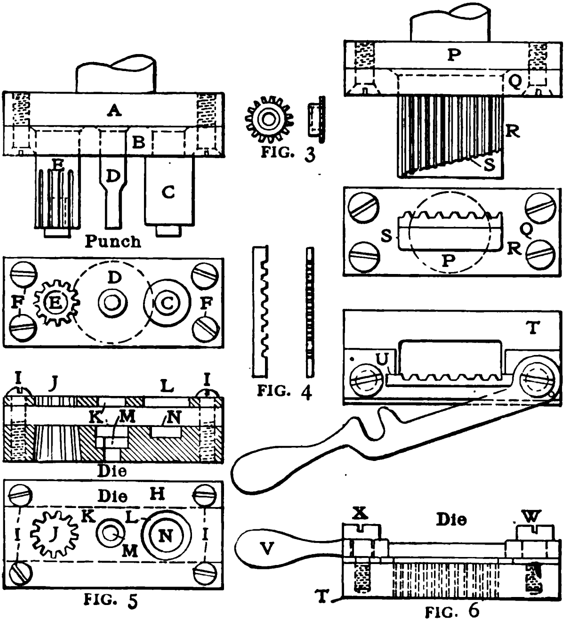
FIG. 2. — Another Way of Disposing of Scrap.

Fig. 2 was made for a special job, that of making bicycle chain side-bars from narrow strip steel by shearing off the ends and punching the holes. Here *A* is the stop-pin, just a straight, round pin driven in a hole in the die and filed flat on one side. This was only to locate the strip approximately, the pilots in the blanking punch making the final adjustment. The portion of the strip marked *S* represents the side-bar, and the portion marked *O* is the scrap. The problem here is to get rid of this small scrap of metal. As the punch descends it will shear off the ends of the side-bar *S*, and force it down into the hole in the die; but the little scrap *O* remains on top of the die. This, of course, must be gotten rid of as soon as possible, to leave the stop clear for the next stroke. To accomplish this we first tried a spring which would press against one side and flip it out of the way as soon as it was sheared off, but we found that it took a rather stiff spring to get the scrap entirely out of the way, and the spring interfered with the feeding; so we discarded the idea and blew scrap away with an air blast. We had a blower which gave only a few ounces pressure; to this we attached a hose and fastened the nozzle to the punch press in such a manner that it projected over the die as shown at *N*. This was very successful, blowing the scrap pieces *O* about four feet away from the machine.

This die was first made directly opposite from that shown in Fig. 2; that is, instead of having a pair of perforating punches and a blanking punch, we had a pair of perforating punches and a shearing punch; the hole in the die was made the shape of the scrap piece *O*. In this way the scrap metal was punched through the die, leaving the finished side-bar *S* on top, but the hole for *O* was made very close to the end of the die-block, so the side-bar projected over it far enough to be overbalanced when it was sheared off. They did not drop as readily as they should, and often got in the way. The die also was rather delicate and caused considerable trouble, so the idea was discarded.

MAKING GEARS AND RACKS BY PUNCHING

THE pieces shown in Figs. 3 and 4 are a small brass gear and a rack, respectively. The gear was made of sheet brass, $\frac{5}{64}$ inch thick, and was to be drawn to the shape shown, cupped $\frac{1}{8}$ inch deep, with a $\frac{1}{4}$-inch hole punched in the center for the shaft. The drawn part was to serve as a case for a spring. The rack was made



Punches and Dies for Racks and Pinions.

of sheet brass, $\frac{5}{64}$ inch thick by $\frac{3}{16}$ inch wide and $1\frac{5}{8}$ inches long, blanked to the proper size. The pitch of the rack was to be the same as that of the gear, and they were to be used on a small automatic music-box. They were both made and finished in the power press.

Fig. 5 shows the punch and die, which were of the combination or gang type for making the gear. The die, which, of course, was made first, is shown in vertical section and in plan. In the first place, the die was laid out, and the drawing die *N* finished to the shape shown. Next the piercing die was worked out by counter-boring down and letting in a tool-steel bushing *M*, hardened and ground to size. Then the blanking die was roughed out, and a piece of tool steel, turned to the proper size, and milled so as to form a perfect gear of the size required, after being hardened and drawn, was used as a broach and run through the die. The die was relieved with about 1 degree clearance, which is plenty for accurate work of this kind. The four holes for the stripper and gage-plate screws were then drilled and tapped, and the die, after being tempered, was finished.

The punch also is shown in two views. *A* is the punch holder of cast iron, *B* the pad of $\frac{7}{16}$-

inch machine steel, *C* the drawing punch, *D* the piercing punch, and *E* the blanking punch; all, of course, of tool steel, worked out, finished and hardened, let into the pad, and upset in the back as shown. The pad was fastened and held to the holder by the four flat-head screws *F*. The stripper and gage plates for the die were then got out, and after being finished and placed in position the die was ready for work. A strip of soft sheet brass, $\frac{5}{64}$ inch thick and of the proper width, was inserted in the die just far enough to do the drawing, and the punch descending, the piercing and blanking punches entered the die (before the drawing punch started to work) to steady it and hold it rigid while drawing. For the next stroke of the press the work was pushed forward one space, the recess at *M* acting as a gage. The $\frac{1}{4}$-inch hole was pierced, and the next or third stroke completed the operation, by the pilot entering the work and the last punch blanking and finishing. After that a gear was finished at every stroke. As will be seen, in a job of this kind the metal has to stretch lengthwise and draw sidewise;

but this was no hindrance, as the work produced was very satisfactory.

Fig. 6 shows the punch and die for making the rack. In this case the punch was made first. *P* is the holder, *Q* the pad, of machine steel, and *R* the punch, which worked on the shearing principle. The punch *R*, after being milled to the correct shape, size, and pitch, was sheared away as shown back ¼ inch from the face, leaving the back square and flat. This was done to allow the punch to enter the die before it began to cut the work. It was also left heavier than necessary, in order to strengthen it. After being hardened and drawn, it was let into the pad, upset or riveted at the back, and the parts assembled; this completed the punch.

The die is shown in two views below the punch. It consists of the die proper *T*, which, after being roughed out, was broached out by the punch. The screw holes were then let in, and it was carefully hardened and tempered. *U* is the gage plate, which was worked out so as to just accommodate the blank, leaving it projecting on the tooth side about .002. *V* was the lock or binding strap, which swung on the shoulder screw *W*. After the blank was placed within the gage plate *U*, the binding strap *V* was swung and hooked on to screw *X*, causing the blank to be held flat and firm while the punch descended, shearing and cutting, gradually thereby producing a rack with good, clean teeth of the proper shape, and leaving no burs.

This proved to be a very rapid way of doing them, the die being easy to set up and also easy to operate. Making the punch shearing caused it to cut gradually; in fact, if the punch had been left straight, the result would have been different. Instead of the teeth being flat or nearly square at the edge, they would have come out half-round and ragged. This principle we have found to give very good results in a large variety of work where the edge is desired to be anywhere near square, and where the stock which is worked is anything over $\frac{1}{16}$ inch thick. We have often seen a lot of small work of this kind being done in the milling machine when it could have been done in the power press with better results and at not more than one-tenth the cost. The trouble is, some are afraid to try; and will never believe a thing possible until they see some one else going ahead and doing it.

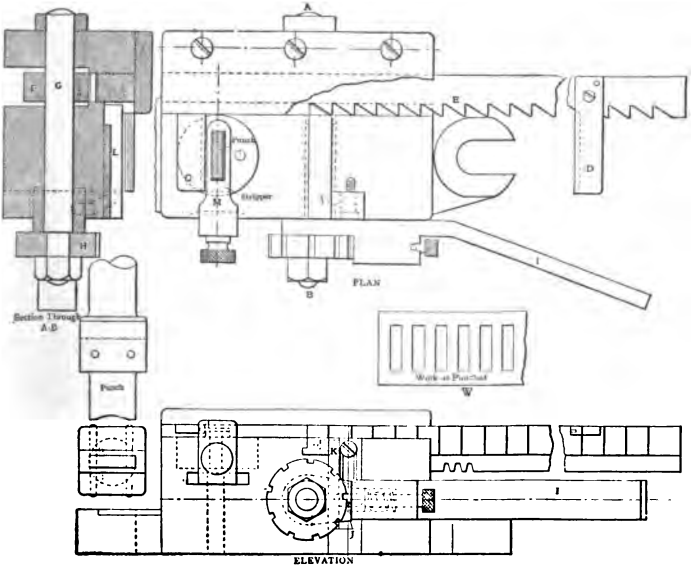


Fig. 7. — An Indexing Punch.

AN INDEXING PUNCH

Fig. 7 shows an indexing punch and die designed for punching slots in rectangular pieces of sheet brass, as shown at *W*. These slots were to be spaced one-quarter of an inch apart.

The piece to be operated on is held endwise in the grooves milled in the arms *C* and *D*. The back edge of the piece rests against the rack, and the front edge bears against a shoulder on the stripper *M*. *C* and *D* are fastened to the piece *E*, which has the saw or ratchet teeth on the side and a regular rack underneath. The rack is moved by the gear *F*, which is fastened on the shaft *G*. Shaft *G* is rotated by the ratchet wheel *H*, which is operated by the pawl *J* and the hand-lever *I*. By moving the handle up the slide *K* is moved simultaneously with it by means of the pin in the slide and a slot in the handle, shown by the dotted lines in the lower view. The slide has an angular groove on the side (shown by dotted lines in the sectional view) which engages with a pin on the plunger *L*. Thus, when the slide is moved up by the raising of the handle, the plunger is disengaged from the rack, and when the handle is moved down the rack is moved along, and the plunger comes into position in time to act as a stop for the index teeth. This die could be modified and used for other rectangular pieces needing to be indexed for the piercing.

INDEXING ARRANGEMENT FOR A PUNCH PRESS

THE sketches, Figs. 8 and 9, show an indexing arrangement for notching, etc., as fitted to a Bliss power press, 2-inch stroke. It is shown as first designed, for perforating ventilator disks with perforations 45 degrees apart (rather an extreme movement for so short a stroke), which it did quite smoothly. It is obvious that with a fine-toothed ratchet instead of the one shown, various spacings could be obtained.

A, Fig. 8, is the platen of the press, *B* is a gray-iron casting, with the necessary boxes cast integral. The tool bolster proper fits on *B*, two studs fastened in the platen project through *B* and the tool bolster, securing them all together when set. The elongated slots are for adjusting for various size blanks — from 12 inches down to about 6 inches. The bolster is of the bridge

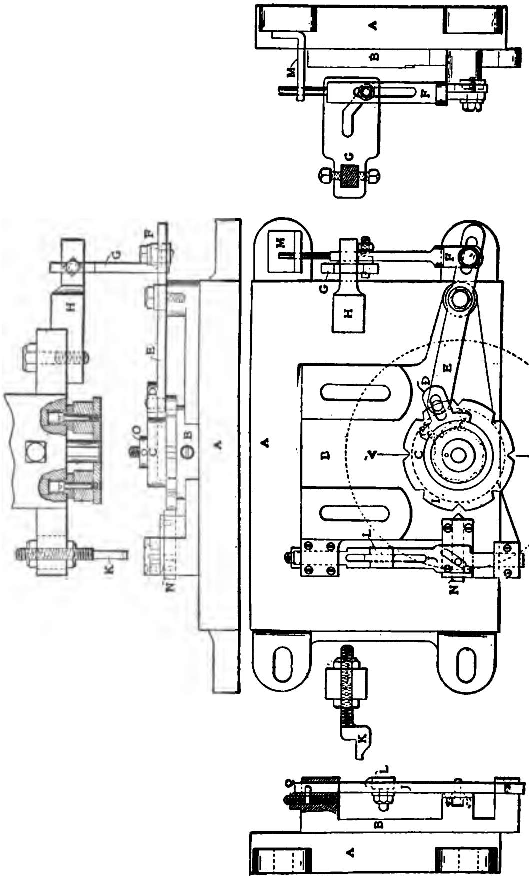


FIG. 8.—Indexing Arrangement for the Punch Press.

type, and with the tool stands the same hight as the threaded collar *O*.

To fully understand the indexing part it will be best to refer to Fig. 9, which is a half section at *A′A′*. *B* is the base-plate, *I* the indexing plate with the ratchet wheel *X* keyed to it. *C* is the top cap with extension *D* for the stud in the lever *E* to work in. The spindle is a working fit in *B* just clear of the bottom. It is grooved and kept in position by the steel plug *Y*; a nice tension is obtained by means of the spring and screw, thus doing away with erratic spacing, or moving back when the cap *C* with its pawl is returning. The extension to the right of the base *B* ends at the boss for the pin and lever *E*. To the left the raised parts are for the sliding

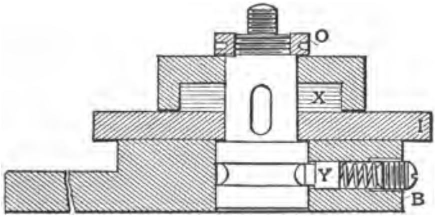


Fig. 9. — Detail of Indexing Arrangement.

bar *J* and bolt *N*. The caps are screwed on as shown.

H is wrought iron fastened to the ram for carrying the cam-plate *G*. *M* is a bracket for the reciprocating lever *F*. *K*, on the other side, is for operating the slide bar *J*.

The front elevation at Fig. 8 shows how we arranged the stripper. The under side of the ram is drilled and tapped to take the two shoulder screws which are bored and counterbored for the cap-screws which hold the stripper plate; the usual rubber pads are behind the stripper. The disks perforated were 11½ inches diameter — shown by dotted lines. The reading of the movement is as follows:

On the down stroke of the ram the cam-plate *G* during the first inch of the 2-inch stroke moves over the lever *F*, pulling the lever *E* which operates the cap *C* till the pawl drops behind the next tooth; the levers are then stationary during the rest of the stroke. On the other side, the finger *K* strikes *L*, causing the bar *J* and bolt *N* to move forward, the bolt *N* bringing the index-plate *I* into position and holding it there. This operation is done in ⅝ of the 1-inch stroke, allowing ⅜ complete dwell for blanking. On the return stroke, the ⅜-inch dwell allows the stripper to shed the blank. The next ⅝ inch the finger *K* leaves the bar *J*. The next 1 inch the levers return to their original position, cap *C* bringing the ratchet and plate *I* with it. The machine is kept going till the spacings are completed. The bar *J* is returned to its proper position by the spring and peg, as shown in section at *Q*. It is best when adjusting the plate *I* in relation to the bolt *N* to let the plate be thrown short so that the bolt *N* will draw the plate and ratchet away from the pawl, and not against it, which it would do if thrown past the center. By adjusting lever *F* along the pin in the cam-plate *G*, the index-plate *I* can be made to stop in any position.

There is nothing complicated about the arrangement; everything is kept as low as possible, the device should go under any press. The angles required to operate the lever *E* through the arc of movement, and *K* for the bar *J*, depend of course upon the stroke of the press.

A NOTCHING FIXTURE FOR THE PUNCH PRESS

One thing that causes a great deal of trouble in a press shop is that in a great many cases the index fixtures are so constructed that when a lot of plates have been notched and the press is changed over onto another type of plate and then there is another order for the type of plates that were cut first, considerable adjusting of the die and the indexing arrangement is necessary to get the notches just the same as they were in the original plates so that the two lots can interchange one with the other. The drawing, Fig. 10, shows an attachment that overcomes this difficulty, the index finger being fixed always in the same relation with the center and the die.

In the first place the dies are made with one side straight and held down by a fillister-head screw while the other side is planed at an angle where the clamping screws are set up to tighten it against the square side of the bolster; the reason for this method being adopted is that all the dies can be easily ground to gage to as fine a limit as is practicable for the work required.

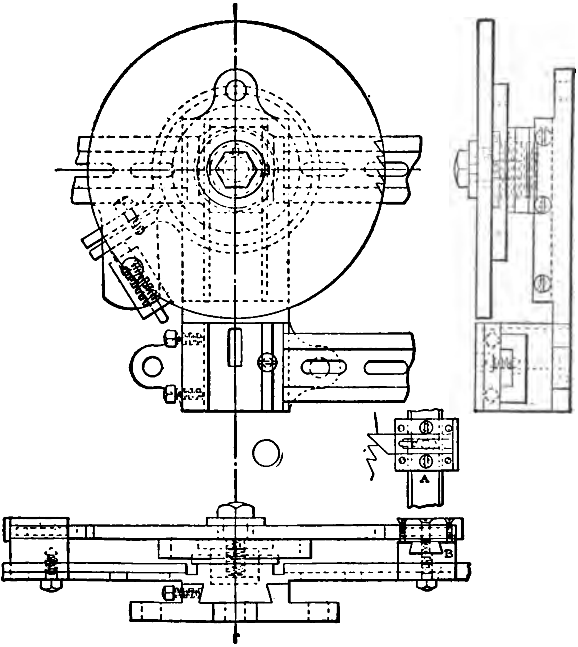


Fig. 10. — A Notching Fixture for the Punch Press.

As shown in the plan, the main part of the fixture is a casting carrying a central post or stud for the plates to revolve on, and having a bolster or die holder which is machined central with the stud. There are also three projecting arms that are slotted out and provided with elongated holes at suitable distances for fixing the index finger and pawl to suit the different diameters of plates. The plan shows also the brake and the spring stop that take up any irregularity in the throw of the pawl and always bring the plate against the index finger. The plates are cast with a ring on the under side that is turned to fit the band brake, which is shod with leather and adjusted with a screw to the required tension. The vertical stud in the fixture is carried by a slide which can be adjusted along a dovetailed slot in the base to accommodate the various sizes of plates, and the lock nuts on the threaded post shown in the side view form means of adjusting the plate vertically to bring it level with the die when the latter is ground. It may be mentioned here that steel-faced iron is good material for notching dies. After a die is ground down $\frac{3}{8}$ of an inch it has lost its size, due to the slight amount of clearance which is necessary. When steel-faced iron is used the thickness of the steel is slightly tapered, and the iron can be backed off so as to give plenty of clearance, leaving enough metal to strengthen the die when it is ground thin.

Of the three cross arms on the fixture, one is to carry the index finger and the other two to carry the pawl slide *A* which is fitted in guide blocks (one of which is shown at *B*) so as to slide freely. Both guides are made so as to be adjusted to suit the different sizes of plates. The amount of throw required is given by the usual adjustable eccentric on the end of the shaft. The indexing pawl is fixed on the sliding bar *A*, as shown, by two screws, and is fitted with a spiral spring (not shown) and also with a stop-pin to keep it from shooting too far out. It is held down by a plate secured by four small screws. The arrangement of the index finger is the same as the pawl, except that it is fastened directly on the slotted arm. Two tapped holes are provided in the under side of the adjustable block, so if one hole comes over the space between the slots the holding-down screw can be put in the other.

FINDING DIAMETERS OF SHELL BLANKS

VARIOUS formulas and tables have been published for finding the diameters of blanks for given sizes of shells to be drawn. Most of these are based upon the presumption that the thickness of the sides of the drawn shells is the same as the original thickness of metal from which they are made, or in other words, that the sides and the bottom are of the same thickness.

Besides, since some of these formulas work from the surface of the shell instead of from the cubic contents, they contain an error which, while being small on light material, is too considerable to be neglected when heavy shells are to be drawn. The tendency of the times is toward heavier work of this nature.

The formula 1 is the result of a plain volumetric speculation. It will give a correct answer under the usual limitations, viz., that the shells are round and the bottom edge sharp drawn, not rounded.

$$1.\quad D=\sqrt{d^2+(d^2-d^2_1),\frac{h}{t}}$$

where

D = diameter of blank,
d = outer diameter of shell,
d_1 = inner diameter of shell,
t = thickness of shell at bottom,
h = depth of shell.

The formula does not make any allowance for trimming the shell after it has been drawn, but this can readily be covered by adding as much to h as it is desired or necessary to trim off.

Formula 2 has been utilized in constructing the diagram shown in Fig. 11. It is not absolutely correct in a mathematical sense of the word, but the error is very small, especially on light material.

$$2.\quad D=\sqrt{d^2+4\,dh\,\frac{t}{T}}$$

where

D = diameter of blank,
d = diameter of shell,
t = thickness of shell at the side,
T = thickness of shell at the bottom,
h = depth of shell.

The curves of the diagram are parabolic, and as marked at the top of the diagram they stand

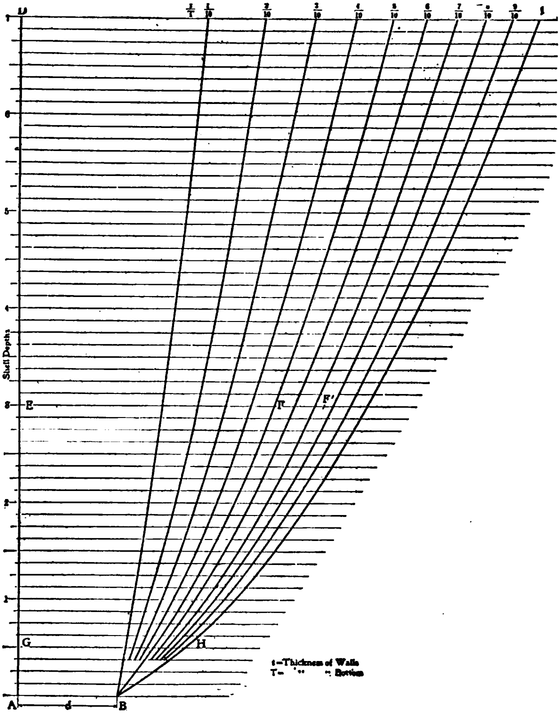


FIG. 11. — Chart for Finding Diameters of Shell Blanks. (One-half Actual Size. Each Half Inch Measurement Should be Considered One Inch.)

for various proportions of t to T. It is obvious, however, that proportions not directly given by the curves can very readily be estimated between the two neighboring ones.

The diagram gives the blank for one-inch shells up to a depth of seven times the diameter. Distance $A\ B$ stands for the diameter of the shell; a half inch on the diagram actually representing one inch. Measure the depth of the shell on the line $A\ D$ and the distance from the point so found to the corresponding curve gives the desired diameter of the blank.

Example:

To find the size of blank for a shell 1 inch diameter, 3 inches deep; thickness at bottom $\frac{1}{8}$ inch, thickness of sides $\frac{1}{16}$ inch. $t \div T = .5$, consequently the curve .5 or $\frac{5}{10}$ is to be applied in this case.

Measure 3 inches from point A on the vertical line $A\ D$; this gives point E and the distance from E to the curve .5 gives the desired diameter of blank $E\ F$, or $2\frac{5}{8}$ inches.

To use the diagram for other diameters than 1 inch, it is to be remembered that since the distance $A\ B$ stands for the diameter, we simply determine a new scale for the diagram and measure the hight $A\ E$ in this scale and also the horizontal line from E to the given curve.

Example:

To find the size of blank for a shell $\frac{5}{8}$ inch diameter, $1\frac{7}{8}$ inches high; thickness of bottom $\frac{1}{16}$ inch, thickness of side $\frac{3}{64}$ inch. $t \div T = \frac{3}{4}$, or .75. The curve for .75 not being drawn in the diagram, we can locate it very readily half-way between curves .7 and .8.

Since distance $A\ B$ represents $\frac{5}{8}$ inch, the scale to be used in this case is $\frac{8}{5}$. The depth $1\frac{7}{8}$ measured in this scale is $1\frac{7}{8}$ times $\frac{8}{5}$, or 3 inches. Three inches from point A we locate E. From E to F', measures $3\frac{3}{16}$ inches. This multiplied by $\frac{5}{8}$ gives 2 inches for the diameter of the blank.

As a third example, we select a diameter of larger size. The diameter of the shell is 4 inches, the depth 2 inches; bottom and sides are of the samė thickness. Since $t \div T = 1$, the corresponding curve is the last one of the diagram.

The scale of the diagram in this case is $\frac{1}{4}$. The depth of the shell in this scale is 2 times $\frac{1}{4}$, or $\frac{1}{2}$ inch; this gives point *G*. Line *G H* measures $1\frac{23}{32}$ in $\frac{1}{4}$ scale, consequently the diameter of the desired blank is $1\frac{23}{32}$ times 4, or $6\frac{7}{8}$ inches.

In looking over the diagram, it will be observed that it shows the influence of the various proportions of thicknesses in a very clear manner.

Formula 2 being more convenient for practical use than No. 1, we give below formula 3, which is a modification of 2, with the object in view to reduce the error. As mentioned above, this is of consequence only when heavy material comes in question.

$$3. \quad D=\sqrt{d^2+4\,d_a h\,\frac{t}{T}}$$

da stands here for the outer diameter of shell less one thickness of the side.

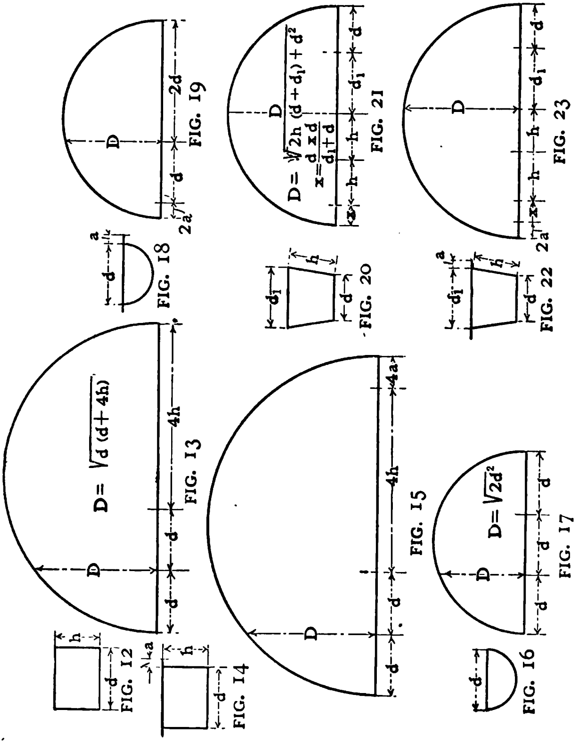
Formula 3 can also be used to good advantage when the thickness of the side of the shell is not uniform. In this case it is only necessary to substitute the average thickness of the side for *t*.

ANOTHER METHOD OF FINDING THE DIAMETERS OF SHELL BLANKS

CONSIDERING that the practical man is handier in the use of the dividers than in drawing square roots, we give now another simple method for the finding of diameters of shell blanks, and apply the same also to some other shapes which frequently occur in practice.

The method is based upon the surface of the shell in comparison with the area of the blank and should therefore be used only when light material is to be considered. In case of the flanged shapes the width of the flange should be small in proportion to the diameter.

Fig. 12 shows a cylindrical shell of the diameter *d* and the depth *h*. To find the diameter of the blank, we lay down the diameter *d* of the shell twice on a horizontal line Fig. 13, add to this a distance equal to four times the depth *h* of the shell and describe a semicircle of which the total distance is the diameter. The vertical line *D* from the intersecting point with the circle to the horizontal line gives the desired blank diameter. Line *D* is to be drawn at a distance *d* from the end of the horizontal.



Finding the Diameters of Shell Blanks.

If the shell has a flange as in Fig. 14, we add four times the width of this flange to our horizontal line and proceed as above, see Fig. 15.

In the case of a hemisphere, Fig. 16, we lay down the diameter three times on our horizontal line and draw the vertical line at the distance *d* from the end, as in Fig. 17.

If the hemisphere has a flange as in Fig. 18, then we add a distance equal to twice the width of the flange to the horizontal line, as in Fig. 19.

In any case the length of the vertical line *D* gives the desired diameter of blank.

If a shell with tapering sides, Fig. 20, has to be drawn, we have to multiply first the bottom diameter by itself and divide the product by the sum of the two diameters d' and d in order to obtain the length x. Otherwise we proceed as shown in Fig. 21.

If the taper shell has a flange of the width a, Fig. 22, we add to the base line of the diagram twice this width, as shown in Fig. 23.

WORKING ALUMINUM

ALUMINUM alloys may be worked in as many shapes and forms as brass with similar methods and tools, but under modified conditions to suit the different nature of the metal.

The tools employed in forming aluminum in the different shapes include all the known methods used in working that metal for manufacturing purposes after it leaves the mills.

The most serious difficulties to be encountered in working aluminum are "hooking-in," clogging and squeaking, in drilling; tearing and "gouging-in," in milling and planing; "jamming" up or blocking of punchings in dies, and consequent breaking of punches; the cohesion of fine particles of aluminum, compressed hard to the cutting edges of punches and inside of dies, and on bending or forming dies, scratching the aluminum; parting or breaking the metal in drawing it.

To avoid trouble in drilling, milling, and planing, the front cutting edge of the tool should be at right angles with the metal cut, and at the back or bottom of the cutting edge there should be about 15 degrees clearance. The cutting edges should be carefully sharpened with an oilstone, and the metal should be removed or cut with a high speed, but the cut should be light, both in depth and feed. In drilling a straight-fluted drill is best; if a twist drill is used, the front of the cutting edges should be ground straight. Soap water, kerosene, turpentine, or lard oil can be employed as a lubricant for both drilling and tapping. For milling or planing no lubrication is necessary to produce good work.

In cutting dies for aluminum there should be at least 1 degree clearance. If the blank is over $\frac{1}{16}$ inch thick and a smooth, uniform edge and exact size of blank are required, it should be recut or "shaved" in a second die, which should be made straight on the inside cutting edge for not more than the thickness of one block — or two at the most — in order that the die may retain its exact size after re-sharpening. Allow about 0.01 inch on the outside of the blank for shaving to $\frac{1}{8}$ inch of thickness, but if the blanks are of a hard aluminum alloy, half that amount will be sufficient.

The cutting edges of both punch and die should be sharpened very smoothly after grinding with an oilstone.

Lard oil or melted Russian tallow, the best for lubrication, should be used on both sides of the metal.

Punches and dies should be carefully cleaned occasionally of the fine particles of aluminum that will be found adhering to the edges.

In drawing aluminum of a thickness not more than $\frac{1}{23}$ inch and a depth of draw more than $\frac{1}{4}$ inch, to avoid the tearing or wrinkling of the blank, it should be held between a ring supported on pins and springs, and the face of the punch, rather than between the edge of the forming cavity of the punch and the sides of the forming block, as is the case in a draw-plate die; but, however it may be held, after it is drawn up first in U-shape — redrawing several times if necessary in ordinary draw-plates and plungers — care must be taken not to employ too fast a speed in the operation, or the work will break at the bottom through too sudden impact.

If the aluminum to be drawn is thicker than $\frac{1}{32}$ inch, it can be drawn direct, without the spring ring mentioned above, to a depth of $\frac{3}{8}$ inch, or even deeper, the exact depth depending largely, of course, upon the composition of the aluminum alloy, the shape of the article to be produced, the finish on the dies, and the speed of the press.

Aluminum is not a suitable metal to work in compound or sub-press dies, as the number of pieces of this metal that can be punched out without putting the dies out of commission by clogging, and consequent breaking of punches will not be sufficient to pay for the cost of the tools.

Bending or forming dies for aluminum should have all the friction parts very smooth and polished in the direction of the draw or bend; that is, the grain of the die and punch should be in the direction in which the metal travels in the die. Lard oil should be used on both sides of the work.

In spinning aluminum, best results are obtained by employing a high speed, with a light pressure of the spinning tool, evenly and gradually applied. Aluminum may be stamped under a drop-hammer with about the same weight and momentum as required for silver.

To produce the proper surface finish on aluminum, it should be first dipped in caustic soda or muriatic acid, to get the oil off after the press work is done, then washed off in cold water and dried in sawdust.

"Satin finish" is produced with a circular, fine brass wire brush running at a speed of not less than 2500 turns per minute. Care must be taken not to burn the work in the operation. After dipping again in a solution of caustic soda, the work is washed off in cold water, dried in sawdust, brushed off with a soft hair brush by hand, and wrapped in soft tissue paper to prevent scratching or getting dirty. If a smooth polish is wanted, it can be given to the surface by buffing, but without "rush"; and aluminum parts, especially castings, can be nickel-plated to good advantage. It is also possible to enamel this metal any color; a very nice effect can be produced by engraving or chasing, as on silver, and a good alloy will keep bright a long time.

HINTS FOR DIE MAKERS AND USERS

THE following are a few kinks that have been gathered in a long experience, in the making and using of dies for the tin-box trade. We once saw a die which, when new, produced a perfect lid for a caddy, but after being in use a short time this die needed refacing, on account of the top tool having been upset to keep it cutting clean. When it had been faced we could not get it to draw the lid equally all around. After much trouble, we traced the fault to the pressure pins. These we found were not all the same length, and they had been changed to different holes. After a few trials we found the right places for the pins. This taught us to be careful when making the pins to get them all right. We now use a beam micrometer when filing them to length.

There are other causes which make dies go wrong, and draw "long spots," as we call them. When our attention is drawn to a die that has developed this fault, we first inquire if the top tool or punch has lately been upset; if it has, we usually find that the face of the tool has been bruised inwardly, this causing the tin to fit tighter in this spot and therefore to be drawn longer. If this is the cause, one can tell by looking at the lid to see if it shows bright where it is longer. Another cause is in the pressure ring and the top tool not bedding with each other. This is another kink for die-makers — that is, take great pains to have the two faces bed with each other. This can be best done on a surface plate.

Another cause is in the pressure ring becoming worn on the block, this causing the work to get between the block and the ring and be nipped tight instead of being pushed off by the ring. The remedy for this is to either make a new ring or to upset the old one in the easy place, and then reface. Another cause of the trouble is in the block becoming worn at the extreme end. This can sometimes be overcome by taking some off the top of the block, and then a new part of the block will be the finishing end. Still another cause is in the pressure bolt becoming bent and therefore causing the rubber to be pressed more in the bent side.

When a die has been in use for a time the top tool, being left soft, becomes worn inside and therefore allows the work when drawn to be lipped at the bottom. This can sometimes be overcome by upsetting on the inside and then refacing; but we have found that on dies with a sunk lid this lipping is sometimes the fault of the spring behind the pad in the top tool being too strong.

Another kink, when upsetting the top tool on the cutting edge, is to strike the face as flat as possible, as this spreads the metal rather than bruising it, as is the case if the tool is hit on the extreme edge and at an angle. A top tool upset will last many times longer if done this way.

When getting out a blank for a cutting edge, we find a good method is to always cut two pieces. This allows you to try one, and then you can find the exact spot on the one left where it wants to be less or larger as the case may be. This is a better way, to our mind, than that used by some die-makers; that is, to cut one blank to the shape as near as can be guessed, and then to mark it out line on line, for in cutting to a line you are apt to cut within.

After the proper shape of blank has been found and the cutting edge has been finished and hardened and the temper drawn, the outline of the blank can be marked on the top tool. After this is done, we find it best, before taking it to the shaper, to file the surplus metal away bevel on the front edge, up to the outline; if this is not done, the shaper is apt to tear the metal on the edge, and cause the outline to be carried away in places.

A top tool, when it comes from the milling machine, should never be scraped with an inside scraper until all the ridges left by the cutter are filed away. If this is not done, the inside scraper will only make the ridges more prominent. This seems a poor kink to give to another die-maker, but we often find new dies with ridges inside the top tool, through trying to scrape them to size before making the surface smooth.

WASHER DIES AND HOW TO MAKE THEM

It does not require a great deal of skill to make a punch or die to punch out a ring with a

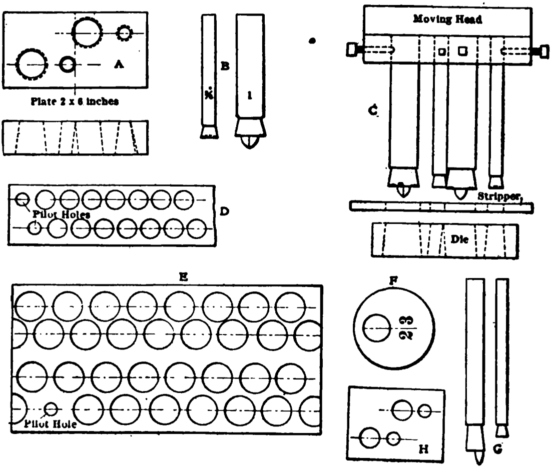


Fig. 24. — Making Small Washers and Checks.

hole in it, but when that ring has a very perceptible "cup" to it and the hole has a ragged, burry edge, the washer degenerates to a "thing" and every one is disgusted.

Now as to the cause of all this trouble. As the hole in the washer is punched first, too much clearance or a dull, rounded edged punch will cause both the cupping and the burring of the hole, and as the punches wear faster than the die an extra set, in first-class condition, should be kept on hand at all times.

Dies and punches for $\frac{3}{8}$-inch washers are shown at *A*, *B*, and *C*, Fig. 24. These are what are termed doubles, that is, two washers are punched out at one revolution of the machine, the press making about 110 strokes per minute, so the operator has to hustle to keep up.

Making the Die

The clearance on the dies should be $\frac{1}{16}$ inch between the hole in the die and the punch, and in planing the die it is well to leave the part surrounding the holes slightly higher. This admits of it being ground when the holes begin to wear, which cannot be done if level.

This form of die is used on all washers up to and including ½ inch and is the most economical washer made, as it saves about one-third of the scrap and gives about one-half more product that a single line of washers.

The proper dimension for a ⅜-inch washer (manufacturers' standard) is outside diameter 1 inch, hole $\frac{7}{16}$ inch, wire gage No. 14 ($\frac{5}{64}$) inch.

REPAIRING THE TOOLS

When the dies and punches become worn the holes are closed in with a beading tool and the punches spread. The die is planed and the punch turned to size, the holes in dies reamed out carefully and then retempered.

In tempering the punches, the pilots should be soft so they will not break off, which they frequently do when left with the usual temper in them.

At *D* and *E* are shown two sheets punched out in "doubles" for this size washer.

MAKING MINE CHECKS

It is a poor manufacturer who cannot find use for his machinery except to supply the one demand, and if the demand for washers is slack the press answers the same purpose for making mine checks. Quite a lot of them are used as we make from 100 to 200 kegs each year. One is shown at *F*, No. 14 ($\frac{5}{64}$ in.) being used for this purpose. They are made in doubles and the pilot is shifted to within $\frac{1}{8}$ inch of one edge as shown at *G*, Fig. 24. *H* shows the die, and the sheets punched out with pilot hole look similar to a sheet punched for washers.

The miners use these checks to mark their boxes of coal as loaded. They are hung on the box and the weighman credits that number with the net weight of coal. Each miner carries about 30 of them and as they are continually being mislaid, lost, and covered up, the demand for them is constant.

LARGER WASHERS

In making 1-inch washers, the metal sheet is No. 9 wire gage ($\frac{5}{32}$ in.) $5\frac{3}{8}$ inches wide and no longer than can be handled easily, say 36 to 40 inches. Punches are similar to those for smaller work but larger and heavier.

This washer is $2\frac{1}{2}$ inches outside, $1\frac{1}{16}$ inch in hole, $\frac{5}{32}$ inch thick. Punches and dies are shown at *A*, *B*, *C*, and *D*, Fig. 25. Dies are made from 2 x 6 inch stock. A well-made die will stand for from 10 to 25 kegs of washers.

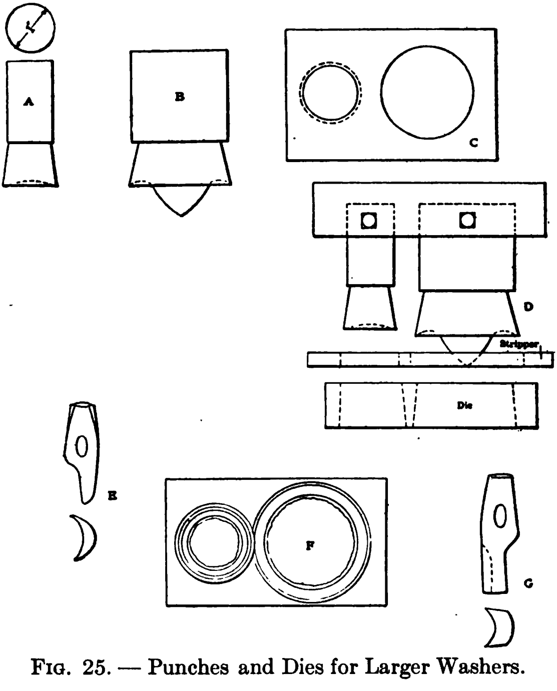


Fig. 25. — Punches and Dies for Larger Washers.

When the die wears it is beaded or peened with a set or hammer as at *E*. This gives it the appearance of *F*. It is then reamed out to correct size and retempered.

The punches when new are made as long as possible, as they wear faster than the dies and consequently need more dressing. They are spread by the tool shown at *E*, annealed, and turned true to size and re-tempered.

It may be asked as to why a web is left between each hole or why there is such a waste of material.

It has been found by experience that it is cheaper to waste the material than to take the time to get out the scrap and to run the risk of spoiling punches and dies by having pieces drop out, and jam under the stripper.

The material is a waste product from steel mills and comes in all sizes and shapes. The strips are sheared to size in a circular sheet shearing machine that does the work very rapidly. The washers after punching are put in a tumbling barrel. Then, after a thorough polishing, they are dumped on a platform and all imperfect ones thrown out. They are then kegged and are ready for shipment.

SQUARE WASHERS

Square washers are out of the ordinary, but they are used to a considerable extent in telephone work, boat and barge building and some other lines, and the demand seems steadily on the increase.

The method of making them is certainly ingenious and shows to what extent a man's mind can go, to overcome a difficult proposition and do work expeditiously and accurately, and at the same time make good use of the machinery at hand.

Fig. 26 shows a square washer with $\frac{9}{16}$ hole, No. 14 sheet metal being used for the purpose.

Two views of the punch are given at *B* and *C*, and in this case it acts as a shear blade also. *D* shows an ordinary $\frac{9}{16}$-inch punch for center hole, and *E* is the die and bottom shear blade. A section of sheet punched out is shown at *F*. The square punch with pilot in center shears two sides of the sheet only, the side next the gage needing no shearing, and the preceding washer having left a square cut, there is nothing for the punch to cut at that point, so the two sides next the operator are all that are acted on. A strip of iron about $\frac{3}{16}$ inch wide is left to pull the sheet along by for the second row of washers.

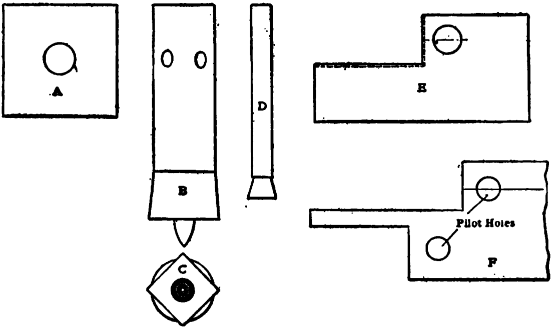


FIG. 26. — Punches for Square Washers.

The square punch will stand plenty of "cup," and the stem should have two depressions for the set screw, opposite each other so the punch can be turned when the cutting edges become worn. And as it wears faster than the die, this plan gives double life to it, which is quite a saving in a day's run.

The sockets for the punches are firmly bolted to the pendulum head, and as can be seen by Fig. 27 it is a lot of work to fit one. By a simple expedient, one socket head is made to do for three sizes of washers by turning the punches eccentric. Take $\frac{1}{4}$-, $\frac{5}{16}$-, and $\frac{3}{8}$-inch washers for example. One socket will do for the three sizes by offsetting the center hole punch, according to the difference of center of holes in the three dies. *J* shows socket die and punches for $\frac{1}{4}$-inch, *K* for $\frac{5}{16}$-inch and *L* for $\frac{3}{8}$-inch washers. Of course, the stem of the punches should be large enough to accommodate the offset, and if this is done it

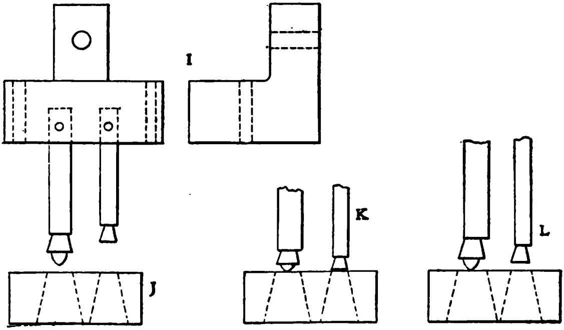


FIG. 27. — Eccentric Punches for Washers.

saves work in fitting and changing socket heads on two sizes of washers.

FLATTENING PUNCHED WORK

We have had a lot of punched work that had to be left very flat and free from "buckle," and the trouble we had to get it out to suit our customer made us think that some of the rest of the press fellows would like to hear about it. We do not know that there is any more trouble in the punch and die business than in any other, but it is often hard work to make a customer understand (especially if he is not a mechanic) why it takes so long to find out how to do a thing, and also why he should be charged for that time when we do not "deliver the goods" in a visible form.

But, to come back to flattening the blanks. First, we had a lot of round disks 8 inches in diameter and $\frac{5}{16}$ inch thick, that had to be flat and not reduced in thickness. The stock was .040 carbon and the blanks had a 2-inch hole in them. Striking them two or three blows between a pair of flat dies had no effect upon them, so we then made a pair of dies like No. 1 in the sketch Fig. 28, the dies being concaved $\frac{1}{16}$ inch and the upper die convexed or "crowned" the same amount. The blanks were struck a good solid blow so as to dish them well, and they were then turned over and struck just hard enough to bring them straight. It took a little practice to get the hang of the job, but after that we had no trouble, and, what was better yet, no kick from our customer.

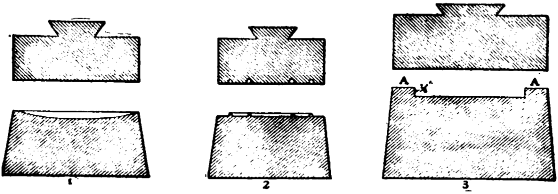


FIG. 28. — Flattening Punched Work.

The next job in this line was a lot of 7-inch disks .035 thick, made of spring copper. Although we knew they must be flat, we did not expect any trouble, but when we reached the flattening part we found trouble waiting for us in bunches. The dies we used on the $\frac{5}{16}$-inch disks would dish the blanks all right, but no kind of a blow would leave them flat. The trouble seemed to be in the spring of the metal, as they all would have a "buckle" in them. Then we made a pair of dies like No. 2, put two rings in them, projections on one face and corresponding depressions on the other, and took care to make a good job. This left the disks pretty good, and by working at them until we got the rings just large enough to take the "slack" out of the blank, they came good and true. The rings also stiffened the blanks and kept them in the shape in which the dies left them.

The next job in this line was a lot of square punchings that had to be brought to a given thickness, and we could do them hot if it would bring the work out any better. We had an old pair of flattening dies; we annealed one of them, and planed it out like No. 3, leaving the sides *A A* ¼ inch high, and then grinding both the sides and the face of the die after hardening. The flattening was done in a light forging drop; the work was heated up to a dark red (or as hot as we could and not raise a scale), and struck one blow. The pieces came out of the dies flat and of an even thickness, but the cost of the work was more than we first estimated.

When the work is very thin, we know of no better way than to grind the dies good and true, lap them together with a little emery and oil, and then set them in the press so that when you put pieces of tissue paper under the corners it will bite all four alike. With a light power drop the cost of flattening thin press work should not be over six or eight cents per thousand. We have a record on the books of a press hand "flat dropping" (as we call it) 44,000 pieces in a day of ten hours, using an ordinary rope drop press.

The trick of straightening a blank with a "buckle" is to first put in a crook that will take out all the "buckle," and then take out the crook.

A METHOD OF HOLDING INSERTED PUNCHES

The method of holding punches inserted in a soft steel holder, as shown in Fig. 29, is by no means new, although quite effective. Having occasion to do considerable punching where the tendency to pull punches out of holder was so great that they became loose, although held in the manner shown in Fig. 29, a good, "husky" screw being used, we adopted the idea shown in Fig. 30, which we found worked to perfection. It will be noticed the end of the screw is flat in this case, giving a good bearing surface, whereas in the scheme shown in Fig. 29, such is not the case, the point of screw (which is flat to conform to the angled flat on punch) having but a slight bearing. It is obvious that any tendency for the punch to pull out will only be the means of

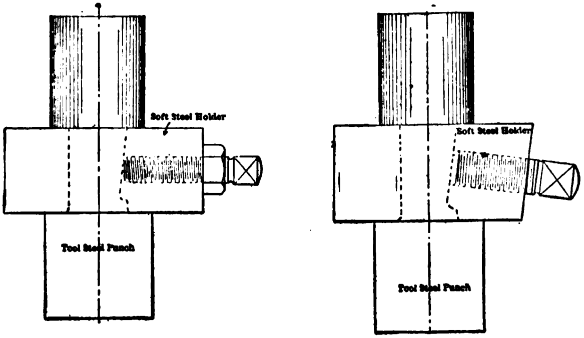


Fig. 29 Fig. 30

Method of Holding Inserted Punches.

its becoming tighter, as it creates an added tension on the set-screw, which for this reason, if no other, makes it unnecessary to use a lock-nut of any kind. The punch should be rammed home by coming down on an end-grain hard-wood block or piece of babbitt before the punch is fastened.

HOLDING ROUND PUNCHES

Fig. 31 shows a good way of holding round punches. Set-screws are not very reliable for this purpose, and are a constant source of trouble on some work. When the block is bored for the punch a straight round cross hole is drilled, cutting into the punch hole nearly one-half its diameter. A pin of cold-rolled steel is used that just fits this hole. The pin is flatted off taper, beginning with very little flat at the head and cutting away, say, two-thirds of the diameter at the other end, and the punch has a beveled notch cut in as shown. When the pin is put in, both it and the punch will roll until the flat surfaces adjust themselves to a bearing and then a little driving will hold the punch securely.

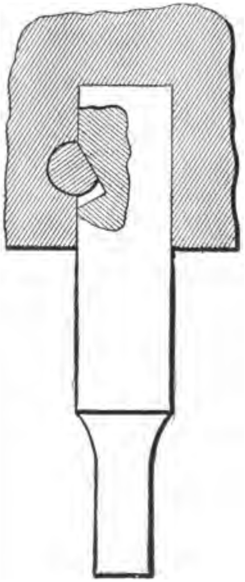


FIG. 31. — Holding Round Punches.

A BOLSTER FOR HOLDING ROUND DIES OF DIFFERENT DIAMETERS

IT is generally the case that in looking for a die bed, or bolster, in the press room, one always finds everything but what is wanted. Fig. 32 will show how to overcome this difficulty to a certain extent, as one bolster takes the place of many.

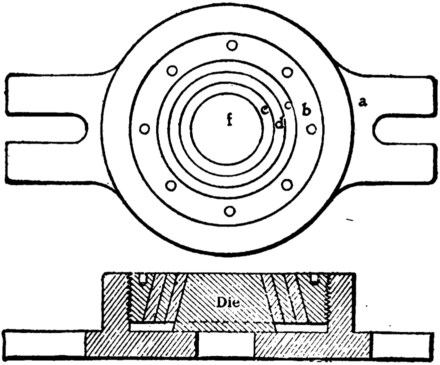


FIG. 32. — Bolster with Rings and Die Blank in Position.

The block *a* is made of cast iron; the rings *c*, *d*, and *e* are of machine steel, each 1 inch larger than the one it fits over, and turned taper inside and out, the ring *b* screwing into *a* having spanner wrench holes drilled in its upper face.

By screwing down ring *b* all are clamped securely together. At *f* is shown the smallest die held in place. The object in having the rings is to enable one to remove any ring and replace the same with the die. The die blanks can be turned to fit duplicate rings, and kept in stock. This arrangement will be found very handy when trimming shells or handling work of a like nature.

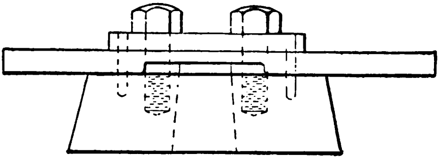


FIG. 33.

PROVISION FOR GUIDE STRIPS ON RE-GROUND DIES

THE scheme here shown may be of some value to toolmakers. It is customary on blanking and combination dies to have projections on the faces so as to grind or sharpen the dies, which makes it necessary to cut a notch in the guide-strip to secure it upon the die, as shown in Fig. 33.

Fig. 34 shows an easy way out of this, by providing for it on the die, leaving a projection on the back edge, say ¼ inch high, so that it may be ground away at the same time the die is sharpened, thus doing away with the notch in the guide strip.

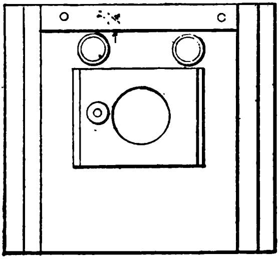


FIG. 34
Providing for Guide Strips.

MAKING LARGE BLANKS WITHOUT A BLANKING DIE

WE once had the job, without blanking dies, of shaping irregular blanks out of sheet or plate, so as to be nearly duplicates. Blanking dies were out of the question on account of the large dimensions of the blanks and the cost.

A regular one-inch punch and die were used, the die projecting about a quarter of an inch above the die block. A templet of quarter-inch plate was filed up for each shape, but as much smaller all around as the distance from the outer edge of the die to the edge of the hole in the die.

With a templet clamped to the stock, and with the templet below against the outer edge of the die, the punch will bite off small pieces of the same shape as the templet. If too big bites are taken, the edge will be very jagged, but by taking a little care it will be smooth enough so it can easily be ground to shape.

SPLIT DIES — MAKING SECTIONAL BLANKING DIES

Many tool-makers believe in making blanking dies in halves or in several pieces, the advantages realized or claimed being ease of manufacture, repairs, and replacement. We have in practice for a good many years made many dies in sections, getting no doubt the advantages claimed above but working for a different object, viz.: the securing of an abundance of shear in a practical and easy manner. The importance of shear and plenty of it cannot be overestimated in die work. A blanking die to cut well and continue to do so should be so made that the material of the punch shall never touch the die, and we have found that a good clearance in practice is 5 per cent. of the thickness of the metal intended to be cut; thus for material 0.03 inch thick, 0.0015 all round should be allowed; for material 0.250 inch thick, 0.0125 clearance is about right.

If a die is properly made and with these clearances, and if provision is made for maintaining the clearance during the cutting operation, the amount of work it will do is incredible. In practice, however, these conditions require some consideration if they are to be fulfilled; the materials of which the dies and even the press are constructed are in a state of equilibrium, and they spring a few thousandths of an inch very easily, although capable of standing much greater stresses without actual damage.

In designing dies, it is therefore important to arrange them so that the stresses at any given instant will be very slight, especially at the starting point, and the only practical way to do this is to provide plenty of shear.

It might be thought that putting the dies in sub-presses would insure the correct alinement of the punch and die, but in practice no amount of guiding or fixing prevents entirely the slight movement under pressure; if the punch and die surfaces are flat or nearly so, when the cutting surfaces of a punch and die come together upon a plate the holding fixtures are forced to accommodate themselves to the alinement of these surfaces. If these surfaces are out of parallel, or if the plate is slightly thicker on one side, or scale or lumps of tin happen to be there, the pressure on the flat surfaces sets up a side stress which no press or fixing arrangement in reason can resist.

We do not wish to be understood as suggesting that the provision of plenty of shear dispenses with the desirability of using sub-presses. We make many dies of sub-press form, the punch and die plates having lugs cast at opposite ends or corners; these lugs are bored to take cold-rolled stock, those in the die for a press and those in the punch for a working fit. We use two sizes only of guides, viz.: 1¼ and 2 inches diameter, which will be found to cover a very considerable range of sizes in a quite satisfactory manner. These guide bars are simply cut off, and the top ends rounded and then forced into the bosses of the die plate. Outside of any assistance the guides give in maintaining the exact alinement, they are more than justified by the facility they give in rapid and accurate setting in the presses; they also insure the safety of the cutting edges in handling and in stores. It is probably unnecessary to add that it is only by using sub-presses that a uniform clearance all around can be secured.

Fig. 35 shows a simple rectangular die made up of sections in the way described, and from which it will be seen that the die is composed of four pieces of steel mitered at the corners. The procedure we have found best in making is first to design the die, or, if this has been done, to take it to the drawing office and lay out the lines where joints of the sections will best come, indicating angles, dimensions, etc. Corners, whether square or round, should always be fitted at 45 degrees, as this gives the strongest corner to the metal. Make additional joints wherever irregularity of shape occurs and, generally speaking, the more sections there are the better, provided, of course, all are sufficiently large to admit of being securely fixed to the base plate.

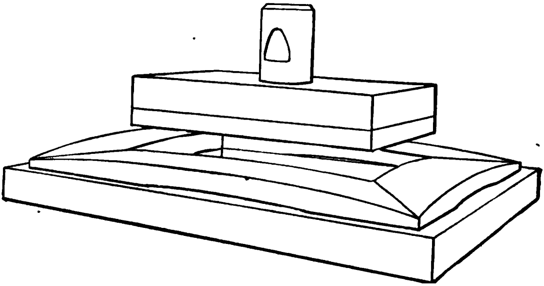


FIG. 35. — A Sectional Die.

The next step is to cut all the pieces from a bar of suitable size and shape, cutting at once to the angles by swiveling the vise and turning the bar over, for getting reverse angles. All the pieces should then be heated and bent to a suitable curvature, to provide a shear of, say one inch in twelve. They are then planed on the concave side an amount almost but not quite sufficient to remove the concavity, and then planed on the cutting edges to a suitable angle for clearance.

The punch and die plates may then be prepared, the guide pins fitted, and the punch finished and fixed in its position upon the punch plate. This plate is then placed upon its guides, and dropped into contact with the die plate, and the sections of the die are fitted around the punch and fixed by screws from the under side, and strong dowels (preferably taper), after which the sections are removed and hardened, then ground slightly upon the top or cutting surface and replaced in position, thus completing the die.

A PUNCH AND STRIPPER

THE sketch, Fig. 36, shows a style of punch that may be of interest to some of our readers. It is used in punching filigree work and in making various kinds of ornaments. The stripper is made of tool steel $\frac{5}{8}$ inch thick. This is laid out from the die after the latter has been hardened, and then the stripper and punch holder are fastened together by screws and the holes for the punches drilled through both pieces. The holes are then reamed with a reamer made from the same size wire as the punch. The reamer is simply a piece of drill rod cut off and beveled slightly on the end that is to do the cutting, after which the wire is ground down on a slant as far as the center and hardened. These reamers work nicely if they are required to take out only 0.003 to 0.005 inch, but will cut large if much

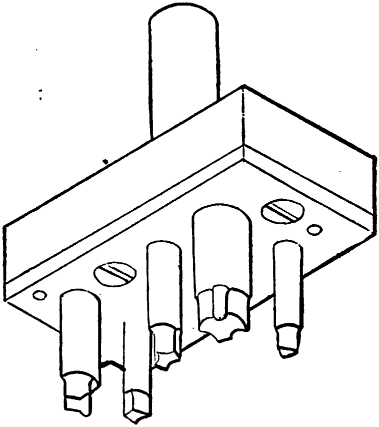


FIG. 36. — Type of Punch.

heavier duty than that is required of them. They are run in a speed lathe or a small drill press. A series of boxes is provided in which is kept wire of all the sizes used on this work, together with a suitable drill and reamer in each box.

After the stripper and punch holder have been reamed, they are taken apart, and the punch holder is countersunk on the back. The drill rods are cut to the required length, headed over on one end and inserted in the punch holder. A small hole is then drilled, half in the holder and half in each punch, and a wire is driven in to keep the punches from turning in the holder. The stripper is secured in place on the die, and the dowel pins are put in, after which the punches are laid out and finished in the ordinary way, hardened and drawn to a spring temper. The punches must fit the stripper as closely as possible, and still be free to slide. The punch holder is secured to the shank by means of two or more flat-headed screws and two dowel pins. Punches made in this way have cut miles of stock in a quick-running press before being worn out. Owing to the thorough manner in which the punches are supported by the stripper, they are very stiff and stand up well to the work. For this work it is well to carry Stub's wire in every size, from No. 60 to ⅝ inch. Where these punches are made in large quantities a good bench lathe with milling attachment is a great time saver.

MAINTAINING THE SIZE OF THE BLANK IN BLANKING DIES

THE method of making a die when it is important to maintain the exact size of the blank depends on the kind of metal that is to be punched through it. If the die is to be used on gold, silver, or soft thin brass, it will give the best results if the clearance is carried up to the extreme cutting edge of the die, as shown in Fig. 37, the punch being left soft and then set out and shaved into the die every time it is set up. This style of die is used in the jewelry industry, and we know of no class of presswork where it is more essential for the punched blank to be cut free

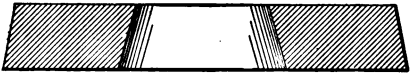


FIG. 37

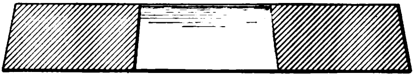


FIG. 38

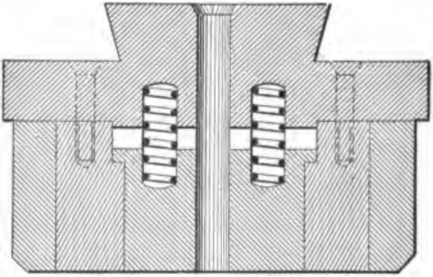


FIG. 39

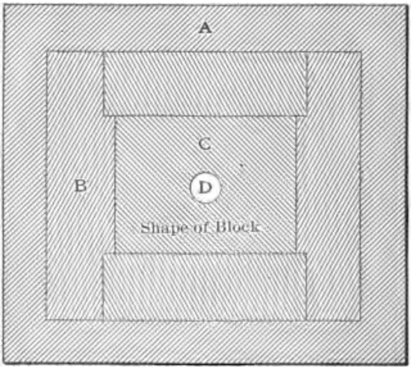


FIG. 40

Making Slow Wearing Dies.

from burr — or barb, as they call it — than in jewelry work. We have seen dies made as described that had been in use years and had trimmed many thousand pieces which had the temper color still on the dies as distinct as when they first left the fire. Of course, a die of this style can be ground a few times and still not change the size of the blank to any great extent.

If the die is to be used on a harder class of stock, such as hard brass, copper or sheet steel, it is better to give it a clearance as shown in Fig. 38, and leave ⅛ to ⅜ inch with just the least clearance, so that it can be ground and still keep the size of the blank intact. A die made in this manner with a well-fitted and hardened punch will run 10,000 to 30,000 blanks of plain sheet iron or steel before it requires grinding, and if the press is in good condition it will punch 1,000,000 blanks before it is worn out.

If the work is on scaly, or, as the press hands call it, "dry" stock, it wears out the die very fast, and if there is a large number of the blanks wanted, a compound die like sketch Fig. 39 will give the best results. The first cost will be double that of a plain die, but it will run off ten times the number of blanks, and the last will be as perfect as the first. The die shown was made after five or six of the regular dies had been made and worn out. A plain die was tried with 1 inch of wearing surface; it was a complete failure, and the work looked like the leaves that drop off in the fall. The force required to push them through the die put them all out of shape.

The die, Figs. 39 and 40, was then made. It was got out in sections and each piece was hardened and ground to size, and then a steel band *A* was got out and machined all over, the inside being left $\frac{1}{32}$ inch smaller than the outside of the die, and it was shrunk on after the die was finished. The punch was made of one piece of tool steel and ground up all over after being hardened. It was sub-pressed with four pins, not shown in the cut, and it ran off between three and four million blanks before it was ground up so short that it could not be used.

The shop cost of the die was $58, and the plain dies cost us $18 each, so there was a saving of 25 per cent on the cost of the tools by using the compound die, to say nothing of the extra quality of the work produced.

There was one thing against the compound die; it was next to impossible to make a change in the shape of the blank and not have to make the whole die all over. The superintendent of a large firm in the electrical line told us they never made a compound die for a field or armature sheet until they had built one and run it long enough to be sure no change was wanted, and in all their experimental work he thought it best to "piece out" the first one and not make a die at all.

METHODS OF DIE-MAKING

WITH the vertical milling machine, or the vertical attachment on the universal, most dies can be made more accurately by taking advantage of their movements than by using the templet to lay out and work to. The die here shown, Fig. 41, was laid out and drilled at the same time with the vertical attachment on the universal machine, it being necessary that it should be accurate so that the blanks produced would assemble correctly.

The die being in two pieces, it was first planed and fitted into the shoe, and in this it was trued up on the milling machine table, by using an indicator, and then it was brought into position for drilling the first hole *a* (shown dotted) which was for the $\frac{1}{16}$ inch radius at *A*, Fig. 41.

The dials were then both set at zero, and the hole was drilled about $\frac{3}{16}$ inch deep (afterwards drilled through on a drill press). The table was then moved forward .161 inch and then .1875 inch crosswise, and the hole at *b* was drilled; then moving back .1875 inch to the center and .1875 inch to the other side hole *c* was drilled. Moving back to zero and forward $\frac{1}{2}$ inch and .1875 inch to each side of the center line, the holes at *d* and *e* were drilled. Coming again to the center and $\frac{1}{4}$ inch forward, the $\frac{7}{32}$ inch hole *f* was drilled, bored, and reamed. This hole was used to pilot the gage, Fig. 42. The boring tool used is shown at Fig. 43. The table was

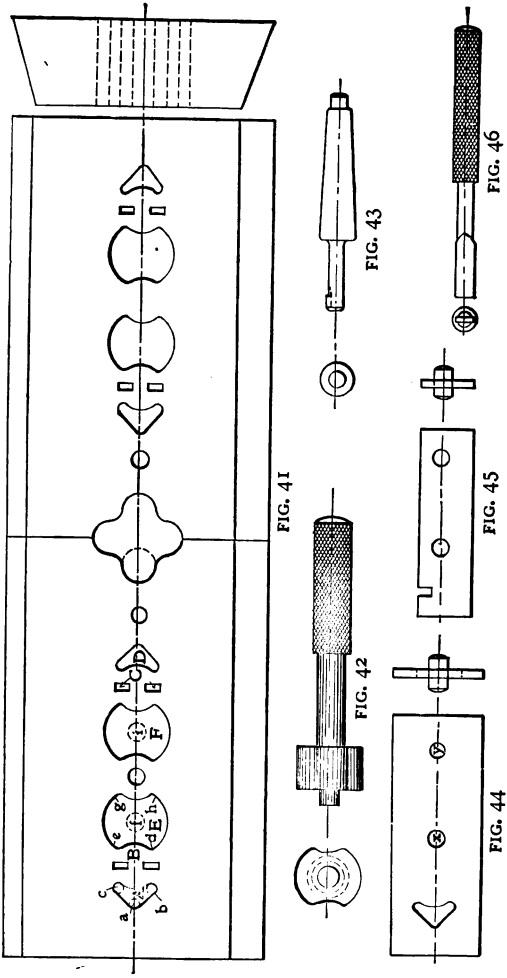


FIG. 41

FIG. 42

FIG. 43

FIG. 44

FIG. 45

FIG. 46

How a Die was Made.

then moved ¼ inch forward and .1875 inch to each side, and holes *g* and *h* were drilled, and so on; the other holes were drilled across the die.

The die was then taken from the milling machine, and the filing templet, Fig. 44, was made by the same method, filed to shape and then hardened in bone. In using this templet the pins *x* and *y*, Fig. 44, were placed in the holes *f* and *i*, Fig. 41, which brought it in position to scribe and afterwards file *A*, and by turning it around it also located *D*.

For locating the slots *B* and *C* a templet, Fig. 45, was made, the slot in the templet being used for piloting the gage, Fig. 46. By turning this templet over and reversing it all the slots were accurately located. The holes *E* and *F* were put in last so as to make use of the pilot holes *f* and *i* in working the others. After filing the die so that all the gages would fit, it was ready for hardening, and when completed it varied .005 inch over all from being exact size; in hardening it shrank .004 inch.

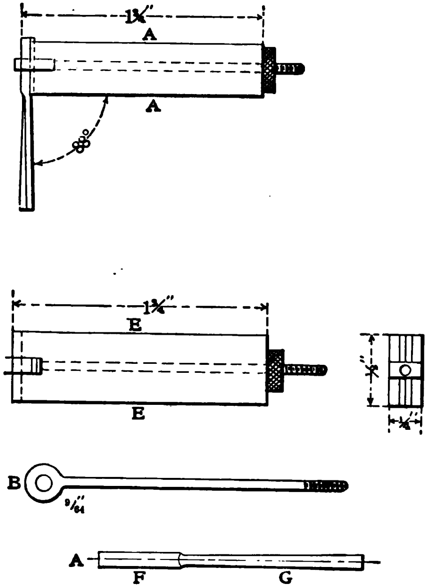


FIG. 47. — Handy Die-Square.

A HANDY DIE-SQUARE

IT has usually been the custom of die-makers to file up a square of sheet steel to give the desired clearance; but this is hardly ever a satisfactory method, as while some will be accurate, many are not.

This square is shown complete in Fig. 47, and consists of a body of $\frac{1}{4}$-inch steel, $\frac{1}{2}$ inch wide and $1\frac{3}{4}$ inches long. The edges *E E* should be ground straight and parallel. At one end is a 90-degree V-slot, $\frac{1}{16}$ inch deep, to receive blade *A*. This slot must be square with edges *E E* and parallel with the sides.

The blade *A* is ground straight at *F*, where it fits the body. The taper portion *G* is ground central with *F* and at any desired angle. The blade is held in place by the draw bolt *B* and the milled nut, which is $\frac{3}{8}$ inch in diameter, so as to be easily turned between thumb and finger. It is a good plan to have a set of blades, varying by half degrees from straight to three degrees.

We have made and used one of these squares to advantage, and believe it is better than the usual square used.

KEEPING TRACK OF PRESS TOOLS

We have all experienced more or less trouble in having to run all about the shop to find certain tools, and have known times when three or four men have been searching for a tool, and after spending several fruitless hours, another one has had to be made to replace it.

These searches became so frequent in one place that it was found necessary to adopt a system for keeping track.

Below is a description of the system used, which worked very successfully, and it may prove equally successful to those who care to adopt it.

We found that the cupboards already used for keeping the tools would serve the purpose very well. These were about 2 feet from front to back, 4 feet 6 inches wide, and contained 4 shelves 9 inches apart. Each cupboard held about 60 or 70 pairs of tools. All blanking tools were usually kept at the front, and tools for successive operations behind them, leaving at the same time plenty of room for getting any of them out without disturbing the others. The tools were then marked each with a distinctly different number. We not only marked the punch and die, but also each part connected with them (including the screws) so that in the event of any tools being taken to pieces, it would be an easy matter to find the dies to which the parts belong.

CUPBOARD No. 2					
No.	**Description**	**Shelf**	**No.**	**Description**	**Shelf**
90			120		
91			121		
92			122		
93			123		
94			124		
95			125		
96			126		
97			127		
98			128		
99			129		
100			130		
101			131		
102			132		
103			133		
104			134		

FIG. 48. — An Index Sheet.

Having numbered all the tools in this manner, we then made an index sheet, as shown at Fig. 48, from which we took blue-prints for each cupboard, giving the description and numbers of the tools therein. These were then fixed inside their respective cupboards, as at Fig. 49, but having about 30 of these cupboards we found difficulty in knowing just where to lay hands on any particular tool without journeying from one cupboard to another. To avoid this we used another set of sheets exactly the same as those previously fixed in the cupboards. We then got the car-

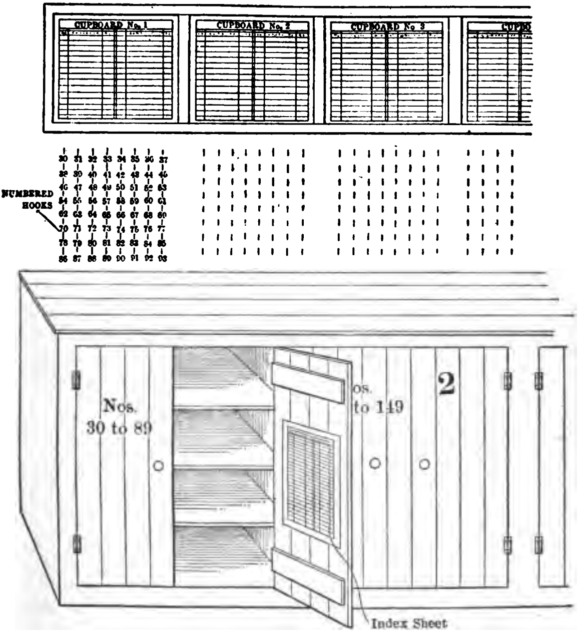


FIG. 49. — Die Cupboards.

penter to make some frames to take these sheets and to fix them over the cupboards as shown at Fig. 49, leaving a fair amount of room underneath for hooks. These hooks were numbered exactly the same as the numbers on the sheets above them. A youth was then put in charge of the tools, his duty being to give the tools out as required, and to see that they were in good working order before placing them in the cupboards again, thus having them always ready for immediate use.

All tool-makers, repairers, and setters were supplied with a dozen checks each, on which were stamped their respective numbers. Now suppose Charlie, the tool-setter, requires a tool; he goes to Harry, the youth in charge, and says, "I want the tools for the second operation for s. s. steel drops." Then Harry, before going to the cupboards, looks down the index sheets placed above them, and if he finds a check on the hook of the same number as the tool required, he is then assured that the tool is out, and a glance at the number on the check will tell him who is in possession of the tool; but on the other hand, should the tool be in its place in the cupboard, he gives it to Charlie and receives in return one of his (Charlie's) tool checks, which he places on the hook of the same number as the tool given out; thus the whereabouts of any tool can easily be ascertained.

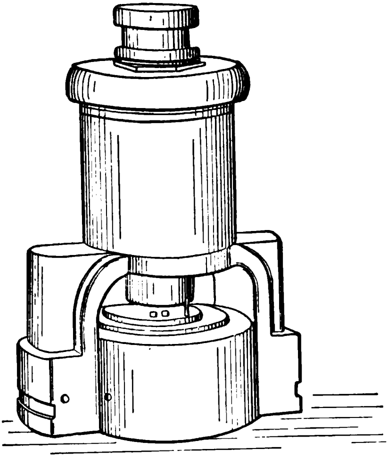


FIG. 50. — The Sub-Press.

THE SUB-PRESS

THE sub-press is a self-contained tool for punching very accurate work, such as parts of watches, clocks, time registers, cyclometers, meters, electrical appliances, and many similar articles where great precision is required. The sub-press is not as well understood by the average tool-maker as it should be, therefore its use is limited to the few who are familiar with its workings. The first cost is of course very high, but this is really all the cost of such a tool, as no damage can be done to it while being set in the press, and the die when rightly made seldom needs any repairs, outside of an occasional face grinding. It is no unusual thing for a set of sub-press dies to cut out from 50,000 to 100,000 blanks without grinding the punch and die faces.

The present detail drawings show the construction more clearly. We think the drawings will be plain enough to be understood with a little description, all the parts being shown in detail in Figs. 51, 52, 53 and 54, while the sectional view shows all the details assembled in their proper places and should give the tool-maker a good idea as to how these dies are made.

In the detail drawings, *H* is the body of the sub-press and *I* is the die base — to which

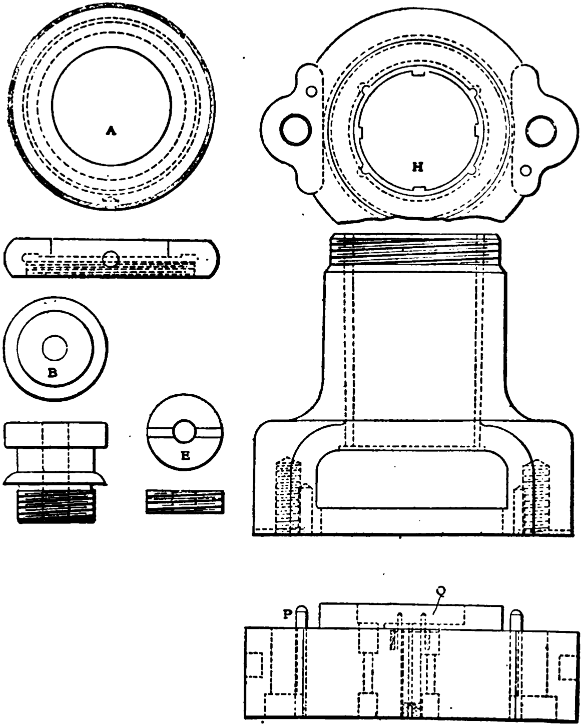


FIG. 51. — Details of Sub-Press.

the body is fastened in the manner indicated in the section. *D* is the babbitt shell for the body, and *C* is the punch plunger. *A* is the tighten-

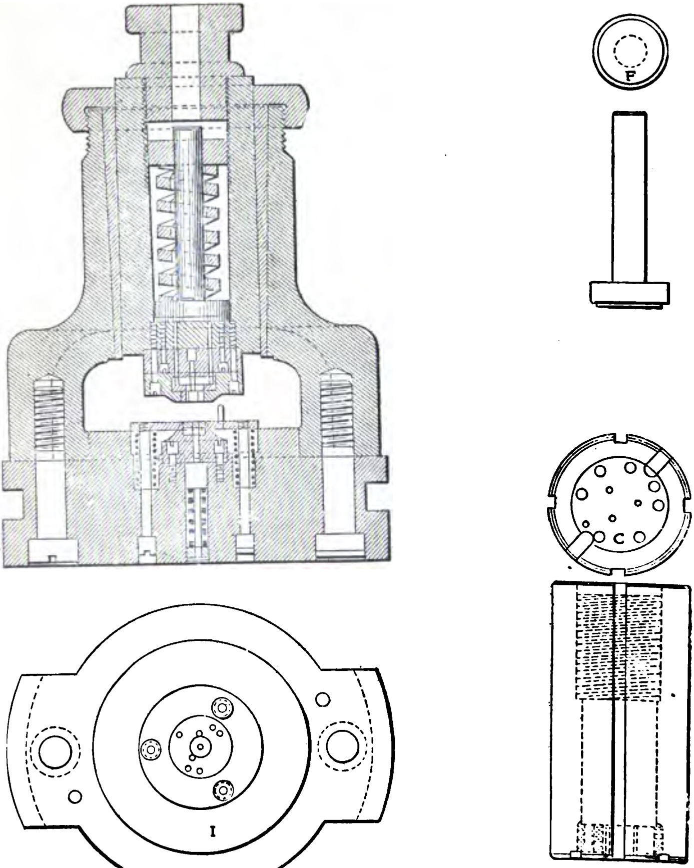


FIG. 52. — Details of Sub-Press.

ing nut for the shell, this nut screwing on the upper end of the body. *B* is the steel neck which screws into the top of the plunger, and *E* is a nut which screws down on spring *J*, this spring being placed in the plunger

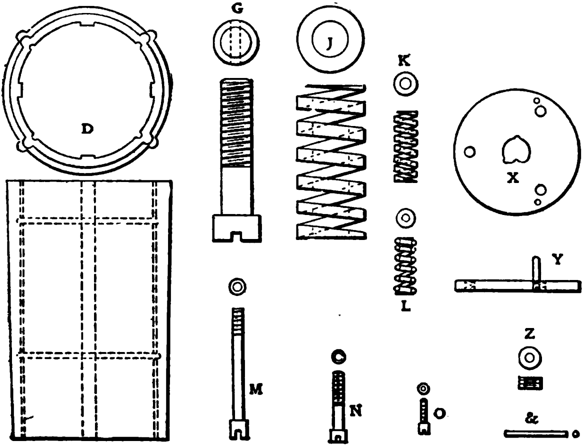


FIG. 53. — Details of Sub-Press.

to operate the punch-shedder piston *F*. *G* shows one of the die-base screws; the die-shedder pad springs are made as at *K;* the base-shedder springs as shown at *L*, and the base-shedder screws as at *M*. Screws *N* and *O* are

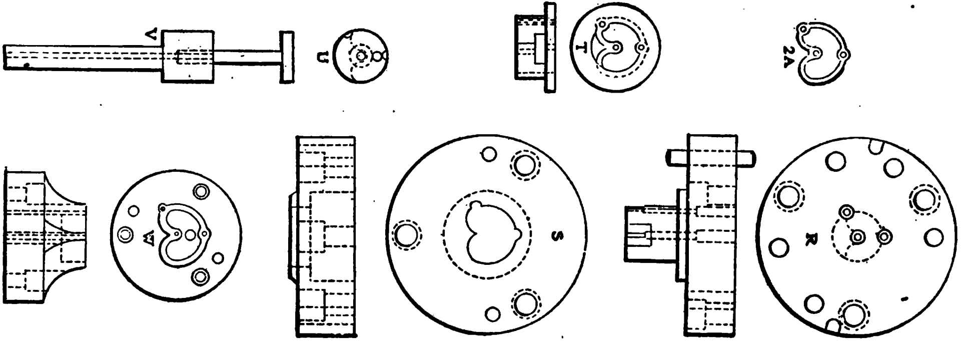


Fig. 54. — Details of Sub-Press Punch and Die.

for punch rim and punch-holder respectively. The die-base steady-pins are fitted as shown at *P*, and the die steady-pins as at *Q*. *R* is the

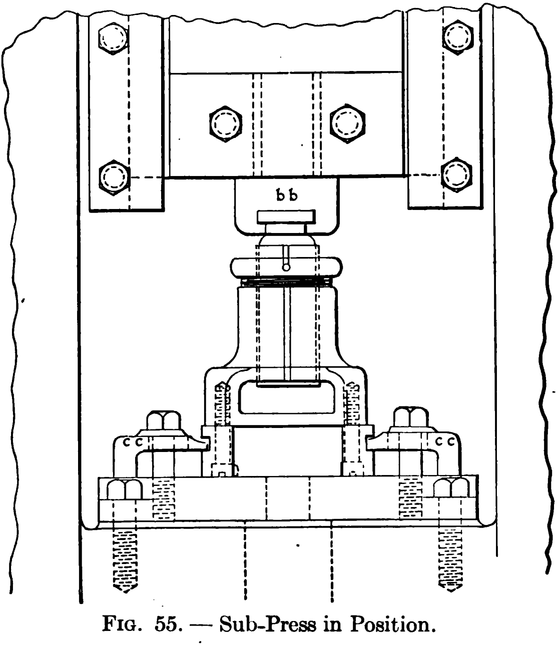


FIG. 55. — Sub-Press in Position.

punch-holder, *S* is the punch rim, and *T* is the punch-shedder ring. The die-shedder pad is shown at *U*, the die-shedder stem at *V*, and the die at *W*. *X* is the base-shedder, and the stock gages are placed in this shedder, as shown at *Y*. *Z* is the die-shedder spring nut; *&* a punch-shedder pin.

A sub-press can be worked in almost any power press of suitable space. However, usually, a special press is used for the purpose, as a short stroke and a stiff arch framed press best meet the requirements.

When we wish to set a sub-press we simply slip it into place, as shown in Fig. 55, by sliding the steel neck on plunger *C* into the press slide hook *b b*, which brings the tool to its proper place. This done we next place the hold-down clamps *c c* into place and tighten the screws or nuts, thus fastening the sub-press firmly to the bed of the power press or bolster plate. We now have the dies set, and are ready to proceed with our blanking. The changing of sub-presses is very quickly done, as no special skill is required. There are several different styles of sub-press frames; the most common is the round barrel arch shape as shown in the illustrations. An overhang pattern is often used. For the very largest work, such as clock or time-register frame backs (large plates with letter stamping and many holes), the four-pillar sub-press must be used. We have known sub-presses to cut quite large blanks from stock as thick as $\frac{3}{16}$ inch. The punching in a sub-press is done in a somewhat different manner than in an ordinary die. Sometimes three or more operations are performed at one stroke of the press — that is, cutting the outside, cutting the center, and lettering a plate or blank all at once. The stock to be punched is securely held between the shedder plates and pads (making a compound die really), these laying the metal perfectly flat while being blanked, and each piece being brought out an exact counterpart of the one previously cut.

In the first-class sub-press the punch does not enter the die proper, but comes just to its face, merely parting the blank from the stock, and no more, the shedders X, U, and F (Fig. 51) forcing the cut blank back into its original place, keeping it flat and its cut edges square. The die and punch faces must of course be perfectly flat and without any shear; this is why a good stiff power press is necessary. For this reason these dies wear much longer and better than the ordinary ones, where the punches pass into and out of the dies, shearing and wearing them quite rapidly, often spoiling them in less than a day's run, especially if in the hands of an inexperienced operator.

The sub-press being a small convenient machine in itself, with its dies and punches always in perfect alinement, is always set ready for work; while its first cost is large, in the long run it is the cheapest die that can be devised for the purpose when accurate work must be had.

Roll-feeds, or other automatic feeding appliances, are often added to the presses in which these sub-press tools are used. As the articles cut are forced back into the places in the stock from which they were punched, the metal strip is kept straight and is easily fed along under the dies at a very high speed, from 60 to 120 pieces per minute being punched. Many shaving and sizing operations are done in dies of this style.

Much more could be said about the good qualities of the sub-press; however, outside of watch, clock, and meter work, this class of tools is little used. But the day is near at hand when its use will be more general.

The piece 2*A*, Fig. 54, is an article produced in the sub-press from which the drawings were made; the piece is shown nearly full size — as are also the details of punch and die which produce it — and the outside and inside as well as the three small holes are all punched at once.

JEWELRY DIE WORK

THIS description of methods of making dies for eyeglass "straps," which some are more accustomed to calling "clamps," may be of interest, especially if the methods herein described are not generally known, and we have reason to believe they are not as well known as they should be. As it is much easier and requires less haste in striking an impression in cold steel than in red-hot metal, this method ought to have a few points to commend it.

In our practice the sample is worked out to shape as usual and soldered to the end of a punch blank taken from the stock. These blanks are turned 1⅛ inches diameter, about 5 inches long, with one end turned taper 2 inches long, with the small end large enough in diameter to well cover the sample. The sample is then soldered to the end of the punch blank, and the outline of the clamp is carefully worked out on the end of the punch in the bench miller. These outlines are carried only about $\frac{1}{16}$ inch from the face when the punch is taken to the shaper and the shape is carried up the punch, but tapering; after which it is carefully filed so that the end of the punch will have the perfect outline of the sample, and that article may then be removed and the face of the punch shaped as the finished article is to appear.

This shaping requires a little exercise of the artist's talent, but it is not so very difficult if gone at with a little system. The systematic method would be to coat the end of the punch with the copper solution, and scribe a line completely around the punch a distance from the end face equal to the thickness of the finished clamp like *S S* in Fig. 56, which line is carried completely around the end of the punch.

Referring now to the other sketches, the sectioned portion *A*, Fig. 57, represents a section of a punch which it is necessary to round off, as in *B* in the same figure; the dotted line *S S* represents from the end of the punch the thickness of our sample and therefore where the rounding should end.

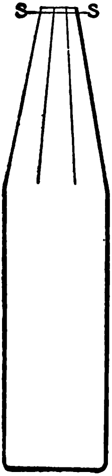


FIG. 56

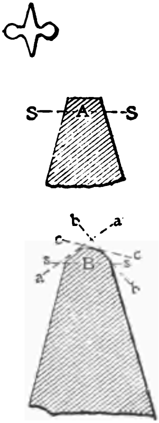


FIG. 57

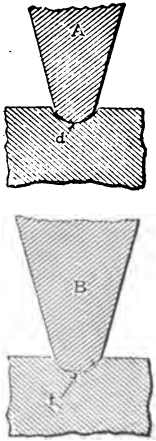


FIG. 58

Jewelry Die Work.

Suppose we are to round the end of our punch to the radius shown; we can begin by beveling or chamfering with a file held at a constant angle, like *a a*, and carry this chamfer all around the punch, preserving the angle and width of the chamfer. By keeping this angle and width the same all around, we gage the amount of metal taken off. This done, change the angle of the chamfer, as *b b*, going all around again and observing the same precautions as to angle and width. Now change the angle of chamfer again, as *c c*, and proceed as before. By this method we can remove the same amount of metal all around, or at opposite points, as the case may be, with the assurance that we have taken it off equally, since we have had a little something to gage our work by, which would not be to easily done if the attempt was made to finish first one-half to a given radius, and then the other.

We can now proceed to file to a finish by continuing to take off the "corners" which the flats *a a*, *b b*, *c c* have left, and so on, depending on the size, etc., of the work, and finally arrive at the finish which is continuously rounding. Of course, different portions of the work are sometimes finished to different radii, but the same rule can be followed where two or more opposite or similar points are to be finished. File all similar parts to the same angle and width of chamfer, to insure the same amount of metal being removed, and, where necessary, change the angle of *a a*, *b b*, *c c*, etc., to give a convexity of greater or lesser radius.

This may seem to some like elementary matter, but we believe that, making this principle known, many will be put on their guard and there will be fewer lop-sided punches such as usually are produced when the attempt is made to originate a form of this kind by finishing the curve first on one side and then on the other. Practice will, in this case, as in all others, lend skill to the hand and eye. We now finish the punch by polishing very highly, hardening and drawing to pale yellow, and burnishing.

Our dies are made of round annealed stock, turned to 1½ inches diameter, the ends faced to about ⅞ inch thick, and the face into which the impression is to be struck finished to a very high polish. Not the slightest scratch is permissible upon the face of either punch or die.

This being done, we can take our punch — which we will now call our "master" punch — and the die blank, to either a screw press or drop press, set both in their respective places, and, when all is in readiness, carefully clean both and oil very slightly with oily fingers. All being firmly fixed in position, the impression is now made. If a screw press is used, a few strong blows will be necessary, and if a drop press — which we prefer — estimate about the proper hight from which to drop the weight with the surface to annealed pieces, which will soon teach one about how much is necessary to strike a given depth. Raise the weight and let fall, catching the weight before a second blow can be struck. The result of this will be a clean-cut impression with the original polish of surface almost perfectly preserved but carried down into the blank. Of course, the metal will be thrown up around the impression, and this can be faced off in either a lathe or a shaper, since it is necessary to strike a little deeper than required because of the edges being rounded. The die is now marked, etc., and hardened, using something to insure it coming out of this process clean, and then the impression is polished out. It is very necessary for work of this kind (in this instance spectacle parts) that the dies, etc., be highly polished, and especially so when working gold-filled stock, for the smoother the work comes from these dies, the less buffing will be necessary to bring it to a finish.

For the high finish, Vienna lime will give excellent results. Chuck a round stick — orange wood — in a speed lathe or drill press. Shape the end with a file while running, and use the preparation with water. We now have a die ready for business, and when this becomes worn large from use, which it surely will do in time, another die can be struck from our master punch.

After a punch has been found to give the results sought for, it is a very good plan to strike off several dies at one time, especially if manufacturing anything like this in large quantities, as there is a gritty surface to annealed pieces which will soon wear out a die, and the form of the piece being changed, will, in a greater or lesser degree, affect subsequent operations. It is a good plan also to strike off one die deeper than is in regular use, finish, and reserve as a master die. This would then make it possible to reproduce the punch also, if by accident or otherwise it became damaged or lost.

To produce a punch from the master die we must, of course, use an annealed blank turned up as before and shaped to the impression in the die. This can well be done by laying out the outlines on the end of the punch blank, shape it accordingly in the bench miller, and file it to about the desired shape. Place the master die and punch in a screw or drop press — screw press preferred for this work — and drive the punch blank into the die, though not hard. Now remove the punch and ease off all spots showing contact. Replace punch blank and repeat until nearly the exact form has been taken, then ease off the sides slightly, polish highly, and return to the press for a finishing blow. The object of this is to work the punch nearly to shape, and to fit the die so that in the finishing blow the first contact will be in the bottom of the impression, as shown in *A*, Fig. 58, which represents a section through punch and die. The metal seems to flow into the die better when contact is at *d* first, and should there be a scratch or other sharp indentation, it cannot be rounded out. It is also interesting to note that if a drop of oil gets pocketed in the bottom, as at *f*, *B*, Fig. 58, this oil will prevent the die being filled out, no matter what pressure is exerted, so that the rule seems to be for either the punch or the die: "Let there be no scratches or dents in either surface; polish highly; keep the surfaces clean from grit, etc., and oiled, but slightly, with slightly oiled fingers, and rubbed on at that." Finish the taper part of the punch in the shaper and vise, as already explained. Polish, harden, and finish as usual.

Quite contrary to what might be expected by many, sinking small dies in this manner does not induce strains sufficient to be of any serious consequence, and we dare say that with annealed steel there is no more chance of loss than by the method of first heating before striking the impression. In fact, an experienced man almost never loses a die.

When not in use the master punch and master die should be coated with vaseline and stored away in a vault or other safe place. If preferred, these tools can be packed in powdered lime, same as polished spring wire is packed, to preserve the polish. If either becomes dull in finish through use or age, it is always well to brighten before using, as results are more pleasing from bright than from dull surfaces.

INDEX

PAGE

Aluminum, bending dies for 36
  cutting dies for 34
  difficulties in working 33
  drawing...................................... 35
  forming dies for 36
  surface finish on 37
  working 33

Bending dies for aluminum...................... 36
Bicycle chain side-bars 5
Blank, maintaining size of in blanking dies....... 69
Blanking dies, sectional....................... 61
Blanks, large, making without a blanking die..... 60
  shell, finding diameters of...............24, 26, 30, 31
Bolster for holding round dies of different diameters 57
  with rings and die blank in position 58

Chart for finding diameters of shell blanks........ 26
Checks, making small washers and............... 42
  mine 44
Cupboards, die 81
Cutting dies for aluminum 34

Details of sub-press........................85, 86, 87, 88
Diameters of shell blanks, finding.........24, 26, 30, 31

PAGE

Die cupboards 81
  makers, hints for 38
  making 73
  punch and, indexing 13
  sectional 65
  square 77
  users, hints for 38
  work, jewelry 93, 95
Dies, bending, for aluminum 36
  cutting, for aluminum 34
  for larger washers 46
  for racks and pinions 8
  for tin-box trade 38
  forming, for aluminum 36
  reground, guide strips on 59
  round, of different diameters, bolster for holding. 57
  sectional blanking 61
  slow wearing 71
  split 61
  washer 42, 46
Disposing of scrap, another way of 5
Drawing aluminum 35

Eccentric punches for washers 50

Feeds, punch-press 1
Finding diameters of shell blanks 24, 26, 30, 31
Finish, satin 37
  surface, on aluminum 37
Flattening punched work 51, 52
Forming dies for aluminum 36

Gears and racks, making by punching 7

PAGE

Guide strips on reground dies 59

Handy die-square 77
Hints for die makers and users.................. 38
Holding inserted punches 54
  round punches..............................56, 57
How a die was made........................... 75

Index sheet 80
Indexing arrangement for punch press........15, 16, 17
  punch and die 13
Inserted punches, holding 54

Jewelry die work 93, 95

Keeping track of press tools 79

Larger washers, punches and dies for 46

Maintaining size of blank in blanking dies........ 69
Making gears and racks by punching 7
  large blanks without a blanking die 60
  sectional blanking dies........................ 61
  slow wearing dies 71
  small washers and checks 42
Method of holding inserted punches 55
Methods of die-making......................... 73
Mine checks...................................42, 44
Music-box, gear and rack for 9

Notching fixture for punch press.................20, 21

Perforating ventilator disks 15

PAGE

Pinions, racks and, punches and dies for.......... 8
Press tools, keeping track of.................... 79
Providing for guide strips....................... 60
Punch and die, indexing.......................... 13
  and stripper................................... 66
  press, indexing arrangement for.............15, 16, 17
  press, notching fixture for.....................20, 21
Punched work, flattening..........................51, 52
Punches, eccentric, for washers.................. 50
  for larger washers............................. 46
  for racks and pinions.......................... 8
  for square washers............................. 49
  inserted, holding.............................. 54
  round, holding..................................56, 57
Punching, making gears and racks by.............. 7
  slots in sheet brass........................... 13
Punch-press feeds, stops for..................... 1

Racks and pinions, punches and dies for.......... 8
  gears and, making by punching.................. 7
Reground dies, guide strips on................... 59
Round dies of different diameters, bolsters for holding... 57
  punches, holding................................56, 57

Scrap, another way of disposing of............... 5
  stop and shear for disposing of................ 2
Sectional blanking dies.......................... 61
  die.. 65
Shear, stop and, for disposing of scrap.......... 2
Shell blanks, finding diameters of.........24, 26, 30, 31
Side-bars, bicycle chain......................... 5

PAGE
Size of blank, maintaining, in blanking dies....... 69
Slots, punching, in sheet brass 13
Small washers 42
Spinning aluminum 37
Split dies 61
Square washers 48
Stop and shear for disposing of scrap............ 2
Stripper, punch and 66
Sub-press 83
  details of 85, 86, 87, 88
  in position 89
Surface finish on aluminum 37

Tin-box trade, dies for........................ 38
Tools, press, keeping track of 79

Ventilator disks, perforating..................... 15

Washer dies................................42, 46
Washers, eccentric punches for 50
  larger, punches and dies for 46
Washers, small, making........................ 42
  square 48
Working aluminum 33

HAVE YOU THESE?

Practical Planer Kinks. By CARROLL ASHLEY. 80 pages, 5 x 8, 34 illustrations. $1.00 postpaid.

Dimensions and Weights of Pipe and Fittings. 11 x 8. $.50 postpaid.

The Electrical Catechism. Compiled by the *Power* editors from *Power*. 5¾ x 7⅞, 246 illustrations. $2.00 postpaid.

Manufacture and Properties of Iron and Steel. By HARRY HUSE CAMPBELL. Entirely revised in 1907, 641 pages, 6 x 9, cloth. $5.00 postpaid.

Precision Grinding. By H. DARBYSHIRE. 6 x 9, cloth, fully illustrated. $2.00 postpaid.

Steam Turbines. By LESTER G. FRENCH. 340 pages, 6 x 9, cloth, fully illustrated. $3.00 postpaid.

Engine Room Chemistry. By PROF. AUGUSTUS H. GILL of the Massachusetts Institute of Technology. 4½ x 6½, fully illustrated. $1.00 postpaid.

Eminent Engineers. BY DWIGHT GODDARD. 280 pages, 5 x 8. $1.50 postpaid.

Combustion and Smokeless Furnaces. By JOSEPH W. HAYS. 112 pages, 6 x 9, illustrated. $1.50 postpaid.

The Compound Engine. By F. R. LOW, editor of *Power*. 48 pages, 6 x 9, 37 illustrations. $.50 postpaid.

Condensers. By F. R. Low, editor of *Power*. 80 pages, 6 x 9, 23 illustrations. $.50 postpaid.

The Steam Engine Indicator. By F. R. Low, editor of *Power*. 208 pages, 6 x 9, illustrated. $1.50 postpaid.

Questions and Answers from the American Machinist. Compiled by FRANK RICHARDS. 420 pages, 5 x 7. $1.50 postpaid.

Chordal's Letters. By JAMES W. SEE. 396 pages, 5 x 8, 32 illustrations. $2.00 postpaid.

The Design and Construction of Cams. By C. F. SMITH, F. A. HALSEY, and others. 70 pages, 9 x 12, fully illustrated. $3.00 postpaid.

Things that Are Usually Wrong. By PROF. JOHN E. SWEET. 52 pages, 5 x 8, 50 illustrations. $.50 postpaid.

Grinding and Lapping. Tools, Processes and Fixtures. By JOSEPH V. WOODWORTH. Author of "*Dies,*" "*Punches, Dies and Tools,*" "*American Tool-Making and Interchangeable Parts,*" etc., etc. 200 pages, 6 x 9, fully illustrated. $2.00 postpaid.

McGRAW-HILL BOOK COMPANY

PUBLISHERS, BOOKSELLERS AND IMPORTERS

239 WEST 39TH STREET, NEW YORK

6 BOUVERIE STREET, LONDON, E.C.

89089665608

B89089665608A

kept

RTEEN DAYS

mped below. A fine of TWO CENTS will be charged for each day the book is kept over time.

incl

Eo ncl

89089665608

b89089665608a